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ABSTRACT

A course of instruction in instructional technology was designed, consisting of pre-recorded audio tapes, filmstrips, and this workbook. The workbook is in looseleaf form with space for notes and is to be retained by the participant on completion of the course. Fifteen units are outlined covering behavioral objectives, tests, stimulus and response, content analysis, and validation. Each unit consists of several stated objects, some background information, a set of questions, and a summary. A glossary is provided. (JY)

ED035313

PRINCIPLES AND PRACTICE

OF

INSTRUCTIONAL TECHNOLOGY

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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This workbook is one component of a course of instruction that includes prerecorded audio tapes and filmstrips. The workbook is to be retained by the participant upon completion of the workshop for use as a reference source when performing the kinds of activities taught by this course.

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The following books are of the highest relevance and we urge all workshop participants to read them:

1. Mager, R.F., Preparing Instructional Objectives, Fearon Publishers

2. Mager, R.F., Developing Attitude Toward Learning, Fearon Publishers

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ACKNOWLEDGMENTS

A workshop of this size and scope does not spring into existence overnight. It has taken over two years to develop PPIT, and during that time many people have poured bits of their souls into the production. In one sense it was a labor of love, since all who were involved are dedicated proponents of the principles and practice of instructional technology. But it was labor, and as such should not go unrecognized.

Credit goes to **Dr. William A. Deterline** for thinking it would be a good idea to do it in the first place, and to **Dr. Richard Otte** and the **U. S. Office of Education** for agreeing with him.

Jacque Hamilton and **Carol Bain** deserve the lion's share of credit for the writing. **Dale Ball**, the project director, is commended for some of the writing and a lot of the push to get the job done. **Dr. Shirley Bitterlich** has again proved that she is one of the most meticulous and skilled editors in the field.

Bob Gearheard and **Rick Hackney** win a blue ribbon for developing the art style and the amusing cast of characters used throughout the workshop. **Karen Worley** and **Jean Forell** receive an award for producing the artwork. **Joan Lewin** deserves a thundering round of applause for the photography and for coordinating art with script.

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GPT owes so much to so many that we cannot name them all. So, to everyone else who contributed to the development of this workshop – our sincere thanks.

David D. Cram, Ph.D.
President
General Programmed Teaching

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UNIT ONE

OBJECTIVES

1. The student will name the three components in the approach to instruction upon which instructional technology is based.

2. The student will differentiate between an educational goal and a behavioral objective in terms of the relative precision with which each is stated.

3. Given a list of statements, the student will correctly label each statement as either an educational goal or a behavioral objective.

4. The student will select the statement that best describes the purpose of writing behavioral objectives.

5. The student will list three advantages of interactive instruction.

6. The student will describe the purpose of validation and explain the validation process.

7. The student will explain why interactive instruction is relatively easy to validate.

UNIT ONE

1. What is the difference between educational goals and behavioral objectives? (Check your answer.)

   _____ A. Educational goals are stated in more general terms than behavioral objectives.

   _____ B. Educational goals are more precisely defined than behavioral objectives.

   _____ C. There is no difference.

2. Why do we write behavioral objectives?

   _____ A. To prepare the groundwork for writing educational goals.

   _____ B. To describe behavior in terms of student performance.

   _____ C. To describe behavior in terms of teacher performance.

3. Label each of the following statements:

   E = educational goal **B = behavioral objective**

   _____ A. The student will know the principles of economics.

   _____ B. The student will explain the difference between kinetic energy and potential energy.

   _____ C. The student will construct an isosceles triangle.

   _____ D. The student will learn to use a slide rule.

   _____ E. The student will recite the Gettysburg Address.

4. What are three advantages to be gained from interactive instruction?

   A. _____

   B. _____

   C. _____

NOTES:

5. What is the purpose of validation? _____

_____

Describe the validation process. _____

_____

_____

6. Is it easier or more difficult to validate interactive instruction?

_____

Why? _____

_____

_____

7. Instructional technology furnishes an approach to instruction that is based on three key components. What are they?

A. _____

B. _____

C. _____

_____

NOTES:

UNIT ONE

SUMMARY

Unit One introduces the principles of instructional technology and discusses the instructional technology approach to the design of effective instruction. There are three key components in that approach: objectives, interactive instruction, and validation.

Objectives are precise descriptions of performance the instruction is to produce, stated in terms of what the student is to be able to do.

Interactive instruction provides two-way communication between instructor and student. There are many advantages to be gained from interactive instruction: for example, the student is kept active; both student and teacher can determine progress at all times; the teacher can adapt to the student's needs and can give immediate confirmation or correction.

Validation is the process of determining inadequacies in the instruction and revising it to eliminate the inadequacies. Interactive instruction is relatively easy to validate because the student's progress can be checked continuously. If the instruction is not effective at any point, it can be revised immediately.

UNIT TWO

OBJECTIVES

1. The student will select the statement that best describes the terms used in stating affective objectives.

2. Given a list of activities indicative of a desired internal state, the student will discriminate between those that would be appropriate in any instructional situation and those that might be inappropriate in some situations.

3. Given a list of statements, the student will identify each as an educational goal, a cognitive objective, or an affective objective.

UNIT TWO

1. A well-written instructional objective describes:
   _____ A. Internal activity
   _____ B. Visible performance

2. An affective goal is concerned with:
   _____ A. Internal behavior
   _____ B. Visible performance

3. Which of the following statements is true?
   _____ A. We state an affective objective in terms of the desired internal behavior.
   _____ B. Even though an affective objective is concerned with internal behavior, we state it in terms of an external and visible activity.
   _____ C. Both of the above statements are true.
   _____ D. Neither of the above statements is true.

4. During a one-week period of observing an "enthusiastic" student of classical music, the following activities were noted:
   _____ A. Spent several hours in the library reading music books.
   _____ B. Argued violently with fellow students after class about the relative merits of the latest "group" (against) and the local symphony orchestra (for).
   _____ C. Was present at every class meeting. (Survey of attendance records showed that student had not missed a single class since beginning of the course.)
   _____ D. Requested appointment to discuss points not covered in class.
   _____ E. Attended concert by visiting symphony orchestra.

   All of the above activities can be used as "indicator performances" in statements of affective objectives. Label each activity:

   A = Appropriate for use in all instructional situations

   R = Might be inappropriate in some instructional situations

NOTES:

5. Label these statements as follows:

E = Educational goal C = Cognitive objective A = Affective objective

_____ A. The student will understand mitosis.

_____ B. The student will have a feel for the scientific method and the nature of science.

_____ C. The student will construct a circle, an arc, and a central angle.

_____ D. Given a list of major bills passed by Congress, the student will be able to select the three which influenced labor and management.

_____ E. The student will voluntarily read about Renaissance art from books that were not assigned in class.

_____ F. The student will talk to other students about the works of Shakespeare apart from test-oriented topics.

_____ G. The student will complete at least one optional assignment of trigonometry problems.

_____ H. The student will have empathy for those whose socio-economic background is different from his own.

UNIT TWO

SUMMARY

An educational goal is a broad, general statement of instructional intent. An objective is a precise description of observable, measurable student performance, and the purpose of writing objectives is to specify our instructional intent. Both cognitive (area of subject matter skills) objectives and affective (area of feelings and attitudes) objectives are important for the attainment of an educational goal.

Even though affective objectives are concerned with internal behavior, there is usually some external indication of the internal behavior. This gives us a means of stating objectives related to an affective state in terms of visible, measurable student performance. When we write an affective objective, we specify some external activity that is acceptable to us as evidence of the desired internal behavior.

Care must be taken in selecting the "indicator" performances used in stating affective objectives. They must represent voluntary activities and must be appropriate to the particular instructional setting. For example, if there is any sort of penalty for absence from class, "perfect attendance" would not be an appropriate indicator performance.

UNIT THREE

OBJECTIVES

1. The student will be able to identify the terms that refer to objectives in the cognitive domain.

2. The student will be able to state the three main characteristics of a behavioral objective and give a brief explanation of each one.

3. Given a list of objectives, the student will be able to identify the behavioral terms, the conditions, and the standards.

4. Given a list of objectives, the student will discriminate between those that are adequate and those that are inadequate.

5. Given a list of objectives, the student will rewrite those that are <u>not</u> stated in behavioral terms.

UNIT THREE

1. Which of the following terms usually refer to objectives that have to do with subject matter skills?

____ A. Behavioral ____ C. Behaviorally stated ____ E. Instructional
____ B. Affective ____ D. Cognitive

2. What are the three main characteristics of an instructional objective? Give a brief explanation of each one.

(1) _____
_____

(2) _____
_____

(3) _____
_____

3. Read each of the following objectives. Circle the behavioral terms. Underline the conditions. Draw a wavy line under the standards. If the conditions and/or standards are not stated, record that information in the space provided.

A. The student will be able to list five factors that influence our manpower with respect to import and export of goods.

_____

B. Given the names of five authors and the titles of ten novels, the student will match each novel with its author.

_____

C. Using a French-English dictionary, the student will translate Beaudelaire's poem "Le Lecteur" with no more than three grammatical errors.

_____

D. The student will be able to write an essay describing the events leading to the stock market crash of 1929.

_____

E. Given samples of copper, nickel, and lead, the student will record the color, odor, and texture.

_____

F. Given two algebra problems similar to the example, the student will solve them within five minutes and both must be correct.

Example: $ax^2 + bx + c = 0$

_____

G. Given an alphabetical listing of the first 25 presidents of the United States, the student will be able to name the presidents in chronological order.

_____

H. The student will be able to use a slide rule to compute square roots.

_____

I. The student will be able to draw a right triangle, an isosceles triangle, and an equilateral triangle.

_____

4. Label these objectives.

A = Adequate **NA = Not Adequate**

If you think the objective is not adequately stated, briefly explain why.

_____ A. The student will be able to solve, without error, 20 problems of the form: $ax^3 + bx^2 + cx = 0$

_____

_____ B. The student will write a paragraph about the Supreme Court.

_____

_____ C. The student will type a letter in block format without error.

_____

_____ D. Without using any reference materials, the student will translate a paragraph in English into German with no errors in grammar and no more than one error in vocabulary.

_____

_____ E. Given examples of Doric, Ionian, and Corinthian orders of Greek architecture, the student will be able to see at least two features that distinguish the columns of each order.

_____

5. Objectives are always written in behavioral terms; that is, they must contain an action verb. If any of the following statements does not meet this requirement, rewrite the statement in behavioral terms.

Example: The student will ~~learn~~ write Einstein's mass-energy equation.

A. The student will be able to grasp the difference between an educational goal and an instructional objective. _____

_____

_____

B. The student will be able to list the main characteristics of an instructional objective. _____

C. The student will know objectives that are stated in behavioral terms. _____

D. The student will appreciate Walt Whitman's poem "When Lilacs Last in the Dooryard Bloomed." _____

E. The student will thoroughly comprehend the reason for writing objectives in behavioral terms. _____

F. Given a list of objectives, the student will be able to identify the behavioral terms, conditions, and standards. _____

G. The student will understand the term "affective goal." _____

H. The student will name the two components of an instructional objective that may be either implied or stated. _____

I. After completing Unit 3 of this workshop, the student will be able to sense the difference between adequate and inadequate statements of objectives. _____

J. Given an ambiguous objective, the student will realize whether conditions, standards, or both are needed to clarify the objectives. _____

UNIT THREE

SUMMARY

An instructional objective has three components: terms that identify what the student is to do (a verb that identifies the action), standards that tell how well the student is to perform, and the conditions or circumstances under which the student is to perform.

Care must be taken in selecting the behavioral terms describing the required performance. Some terms may be too general and need to be broken down or qualified. Some are adequate, and others are too vague to be useful. Each term selected must specify an observable and measurable activity or product of that activity.

An objective must always be stated in behavioral terms. However, conditions and/or standards may sometimes be implied. If they are needed to clarify the instructional intent, they must be stated. If they are obvious, they need not be stated.

UNIT FOUR

OBJECTIVES

1. Given a list of ten instructional objectives, the student will underline the observable and measurable terms and will classify each objective as motor performance (MP), verbal (V), or discrimination (D).

2. Given a list of performance requirements, the student will classify each as either MP, V, D, or a combination of these.

3. The student will explain what should be done with an objective that appears to be too large and complex or to consist of many kinds of activities.

4. The student will explain the primary difference between an interim objective and a subobjective.

5. Given an instructional objective, the student will select the subobjectives that are critical for completion of the terminal performance requirements.

6. The student will write a brief statement describing why instructional technologists feel there is value in giving objectives to the student.

7. The student will write a brief statement describing why instructional technologists feel that objectives are necessary and valuable for the teacher.

UNIT FOUR

MOTOR PERFORMANCE	VERBAL	DISCRIMINATION
adjust	cite	choose
align	copy	classify
apply	define	compare
close	describe	contrast
construct	explain	decide
(dis)assemble	letter	detect
(dis)connect	list	differentiate
draw	name	discern
duplicate	quote	distinguish
insert	recite	divide
load	record	identify
manipulate	repeat	isolate
measure	reproduce	judge
open	(re)state	match
operate	transcribe	pick
remove	write	select
replace		
stencil		
tune		
turn off – on		
type		

NOTES:

1. Read and underline the observable and measurable terms in each objective. Mark MP for motor performance, V for verbal, and D for discrimination in the space before each objective.

_____ A. The student will describe the Federal Reserve System in outline form.

_____ B. Given the statistics, the student will be able to draw a bar graph showing cost of living increase in the United States (1965–1969).

_____ C. The student will identify seven kinds of bacteria by labeling an illustration of each.

_____ D. The student will be able to select the tools and equipment needed for a specified chemistry experiment.

_____ E. The student will list two reasons why wind is a limited source of power.

_____ F. The student will be able to construct a circle and a central angle.

_____ G. The student will name nine labor organizations that were attempts to give the laborer better and safer working conditions.

_____ H. Given a list of major bills passed by Congress, the student will be able to select the three which influenced labor and management.

_____ I. The student will record all experimental findings in his class data book.

_____ J. The student will properly focus the lens on a standard microscope.

NOTES:

1. Classify each of the following performance requirements as either V for verbal, D for discrimination, or MP for motor performance, or a combination of these:

_____ A. Writing a report
_____ B. Operate a calculator
_____ C. Classify organisms observed through a microscope
_____ D. Adjust the compass
_____ E. Evaluating a news article
_____ F. Identifying a right triangle
_____ G. Repairing a microscope
_____ H. Explaining repair of a microscope
_____ I. Producing a blueprint

NOTES:

1. What should be done with an objective that appears to be too large, complex and to consist of many kinds of activities? _____

_____

_____

_____

2. What is the primary difference between an interim objective and a subobjective?

_____

_____

_____

3. Read the following instructional objective and select the subobjectives that are critical for completion of the terminal performance requirements.

Instructional Objective: Given a pattern, the student will fasten the pattern to the material, trace the interior design from the pattern to the material, and cut out a duplicate following the pattern outline.

Subobjectives:

_____ A. The student will fasten the pattern on the material.

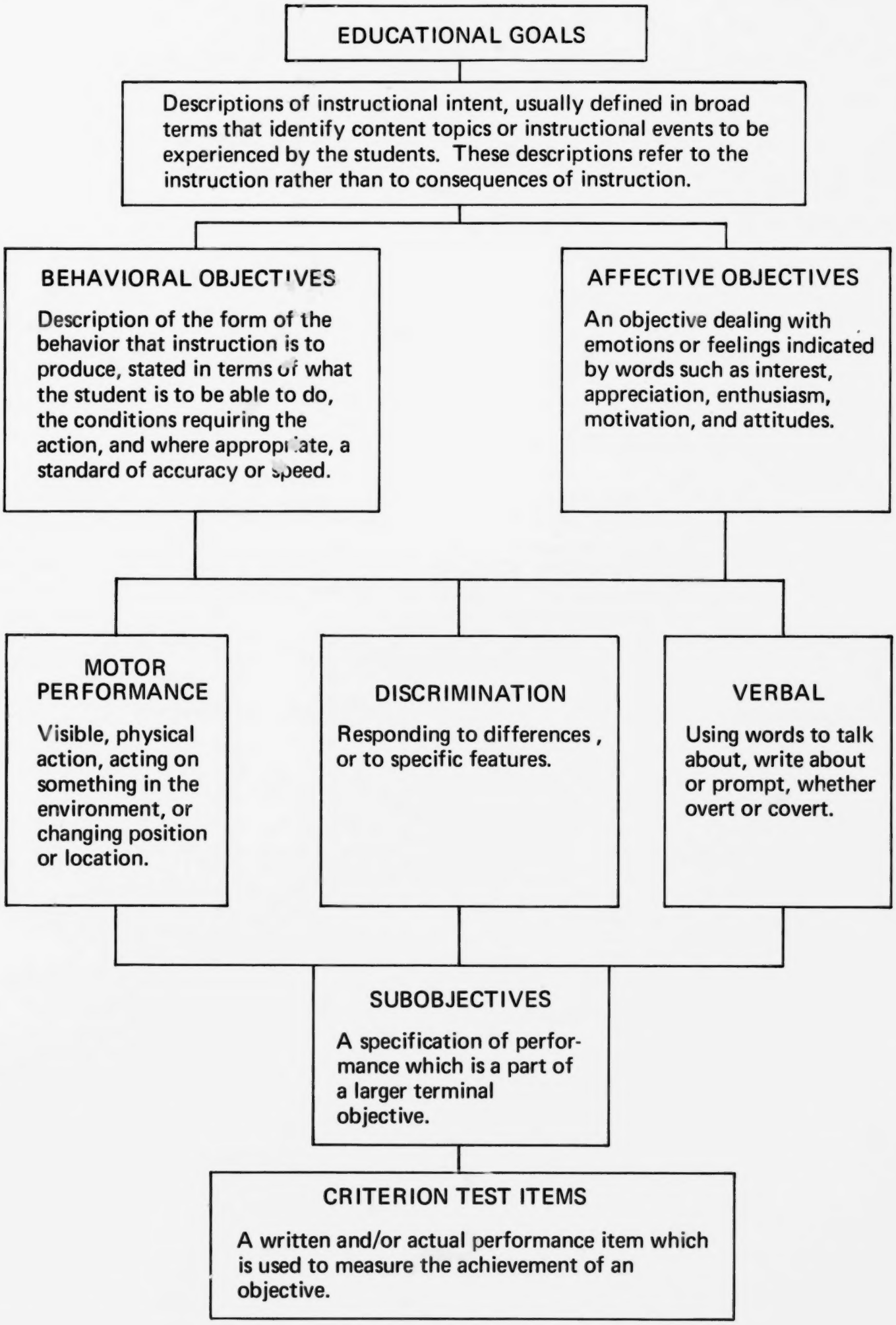
_____ B. The student will select the proper tool to trace the interior design from the pattern.

_____ C. The student will trace the design.

_____ D. The student will describe the procedure of reproducing a copy from a pattern.

_____ E. The student will select the proper tool for cutting the duplicate from the pattern.

_____ F. The student will cut out the duplicate from the pattern outline.


EDUCATIONAL GOALS
Descriptions of instructional intent, usually defined in broad terms that identify content topics or instructional events to be experienced by the students. These descriptions refer to the instruction rather than to consequences of instruction.
BEHAVIORAL OBJECTIVES
Description of the form of the behavior that instruction is to produce, stated in terms of what the student is to be able to do, the conditions requiring the action, and where appropriate, a standard of accuracy or speed.
AFFECTIVE OBJECTIVES
An objective dealing with emotions or feelings indicated by words such as interest, appreciation, enthusiasm, motivation, and attitudes.
MOTOR PERFORMANCE
Visible, physical action, acting on something in the environment, or changing position or location.
DISCRIMINATION
Responding to differences, or to specific features.
VERBAL
Using words to talk about, write about or prompt, whether overt or covert.
SUBOBJECTIVES
A specification of performance which is a part of a larger terminal objective.
CRITERION TEST ITEMS
A written and/or actual performance item which is used to measure the achievement of an objective.

1. Describe briefly why we feel that objectives are so necessary and valuable for the teacher. _____

2. Describe briefly why we feel there is value in giving our objectives to our students.
_____

NOTES:

UNIT FOUR

SUMMARY

Having objectives available presents various advantages to both the student and the teacher. They help the teacher determine what content should be taught and where he should put the most emphasis. In the same way, a student who has the course objectives will know what areas will be emphasized and what the teacher expects him to achieve by the end of the course. These factors lead to a more efficient and effective course of instruction.

Stress is placed on the type of performance called for by the instructional objective. The validity of a course of instructions based on appropriate objectives and test items depends on the communication of required performance stated in well-defined terms. For clarification and consistency, objectives are placed in three categories:

1. Discrimination Objective – involves the ability to describe or select two or more similar alternatives.

2. Verbal Objective – involves the ability to write or describe orally.

3. Motor Performance Objective – involves the ability to demonstrate a motor skill.

Any of the three classifications of objectives could be combined, depending on the requirements of the terminal objective. A verbal objective might be a subobjective of either a discrimination objective or a motor performance objective, and in like manner a verbal objective might require either the ability to discriminate between various choices or the performance of some motor skill.

Verbalizing a pattern or sequence of performance before the actual performance occurs, or "telling yourself what to do," is an activity that proves valuable and sometimes essential in reaching the terminal objective. This activity can be classified as an interim objective. Interim objectives are temporary patterns stated in action terms that aid the student in completing the terminal performance requirement.

A subobjective is performance that is part of a larger terminal objective and appears as part of the terminal performance. Subobjectives appear when large sequential tasks are involved. The primary difference between subobjectives and interim objectives is that subobjectives appear as part of the terminal performance, while interim objectives serve a temporary purpose.

NOTES:

UNIT FIVE

OBJECTIVES

1. The student will describe in writing the advantage in developing criterion test items before developing objectives.

2. The student will list the three primary functions of the criterion test.

3. Given a list of objectives and test items, the student will classify the behavioral requirements stated in the objectives and test items.

4. Given a list of objectives and test items, the student will distinguish between appropriate and inappropriate test items, and will explain why any test item is inappropriate.

5. Given an instructional goal, the student will write four objectives and four relevant criterion test items.

UNIT FIVE

	OBJECTIVE	TEST ITEM	CLASSIFICATION OBJECTIVE	CLASSIFICATION TEST ITEM
___ A.	Fill in form	Fill in form	V	V
___ B.	Operate calculator	Operate this calculator	MP	MP
___ C.	Adjust microscope	Name adjustment parts of a microscope	D	V
___ D.	Write the equation for Ohm's Law	Write the equation for Ohm's Law	V	V
___ E.	Solder connections	Indicate which connections are acceptable	MP	D
___ F.	Explain use of micrometer	How is the micrometer used?	_____	_____
___ G.	Use the compass	Which way is north?	_____	_____
___ H.	Select the definition for "interaction"	Which of the following is the definition of "interaction"?	_____	_____
___ I.	Explain function of a prism	List, in order, the colors of the spectrum	_____	_____
___ J.	Describe a micrometer	Measure this	_____	_____
___ K.	Define "laser"	Explain how a ruby laser works	_____	_____

NOTES:

1. What would be the advantage in writing criterion test items before developing objectives? _____

_____

_____

_____

2. List the three primary functions of the criterion test.

A. _____

_____

_____

B. _____

_____

_____

C. _____

_____

_____

_____

NOTES:

1. Read the following brief statements of objectives and test items and decide whether the corresponding test items are appropriate or inappropriate. If they are inappropriate, explain why. Classify each objective and test item as verbal (V), discrimination (D), or motor performance (MP).

	OBJECTIVES	CLASS	TEST ITEM	CLASS
A.	Cite orally the five largest cities in the world	_____	Name the five largest cities in the world	_____
B.	Trace the flow of blood through the heart on a diagram	_____	Describe the structure of the heart	_____
C.	Select the equipment needed for a given chemistry experiment	_____	Select the proper equipment for this chemistry experiment	_____
D.	Locate a malfunctioning tube in a radio	_____	What meter is used to test radio tubes?	_____
E.	Define "objective"	_____	Define "objective"	_____
F.	Deliver a five minute extemporaneous speech	_____	Describe how to organize for an extemporaneous speech	_____

2. A new course, based on objectives and a criterion test, has undergone a series of tests and revisions. All students score about 95% on the criterion test, but only 31% can perform the task. What's wrong? _____

1. Instructional Goal

The student will know how to punctuate sentences, following conventions and rules regarding acceptable use of the period, comma, colon, semicolon, question mark, exclamation point, quotation marks, apostrophe, etc., both from the point of view of mechanical usage and to clarify and emphasize intent of each sentence.

Write four objectives for the goal described above.

(D) A. _____

_____

(D) B. _____

_____

(V) C. _____

_____

(V) D. _____

_____

Write four test items for the above objectives.

(D) A. _____

_____

(D) B. _____

_____

(V) C. _____

_____

(V) D. _____

_____

Examples of objectives and test items

OBJECTIVES

(D) A. Given four sentences, the student will correctly punctuate them using the colon, semicolon, and the quotation mark.

(D) B. Given four sentences, the student will punctuate those that should be punctuated with a colon and those that should be punctuated with a semicolon. This should be done without error.

(V) C. The student will be able to write a paragraph correctly illustrating at least five uses of the comma.

(V) D. The student will be able to write the rule for use of the exclamation point.

CRITERION TEST ITEMS

(D) A. Punctuate these four sentences using the colon, semicolon and the quotation mark as required.

(D) B. Punctuate these four sentences using the colon and semicolon as required.

(V) C. Write a brief paragraph illustrating at least five uses of the comma.

(V) D. Write the rule for use of the exclamation point.

UNIT FIVE

SUMMARY

The three functions of the criterion test are: to help us design the instruction, to determine the student's ability to perform, and to evaluate the instruction.

Developing appropriate criterion test items is essential. A test item should measure the behavioral requirement stated in the objective. If an objective specifies verbal performance, the most appropriate kind of test item would be verbal (for example – fill-in or essay). If an objective specifies discrimination, the most appropriate test item would be discrimination (for example – multiple-choice or true/false). If an objective specifies motor performance, the most appropriate test item would be actual performance.

UNIT SIX

OBJECTIVES

1. The student will define "entry level."

2. The student will explain how entry level capabilities are related to the course objectives.

3. The student will identify the method used to determine entry level.

4. The student will explain why we must determine entry level when redesigning an existing course.

5. The student will describe two kinds of errors commonly made when designing a course on the basis of untested assumptions about entry level.

6. The student will state the primary advantage in determining entry level.

7. The student will explain how to adjust an existing course if it is found that entry level assumptions are either too high or too low.

UNIT SIX

1. Define "entry level." _____

2. In your own words, explain how entry level knowledge and skills are related to the course objectives. _____

NOTES:

1. In designing a new course or redesigning an old course we must:

   _____ A. Determine course objectives
   _____ B. Determine range of entry level knowledge and skills
   _____ C. Both of these
   _____ D. Neither of these

2. How do we determine entry level?

   _____ A. Develop a test of relevant entry level knowledge and skills
   _____ B. Determine all course experience

3. When redesigning an existing course, is it necessary to determine entry level capabilities?

   _____ Yes
   _____ No

   Why? _____

   _____

4. If we design a course on the basis of untested assumptions about entry level, what two kinds of errors might we make?

   A. _____

   _____

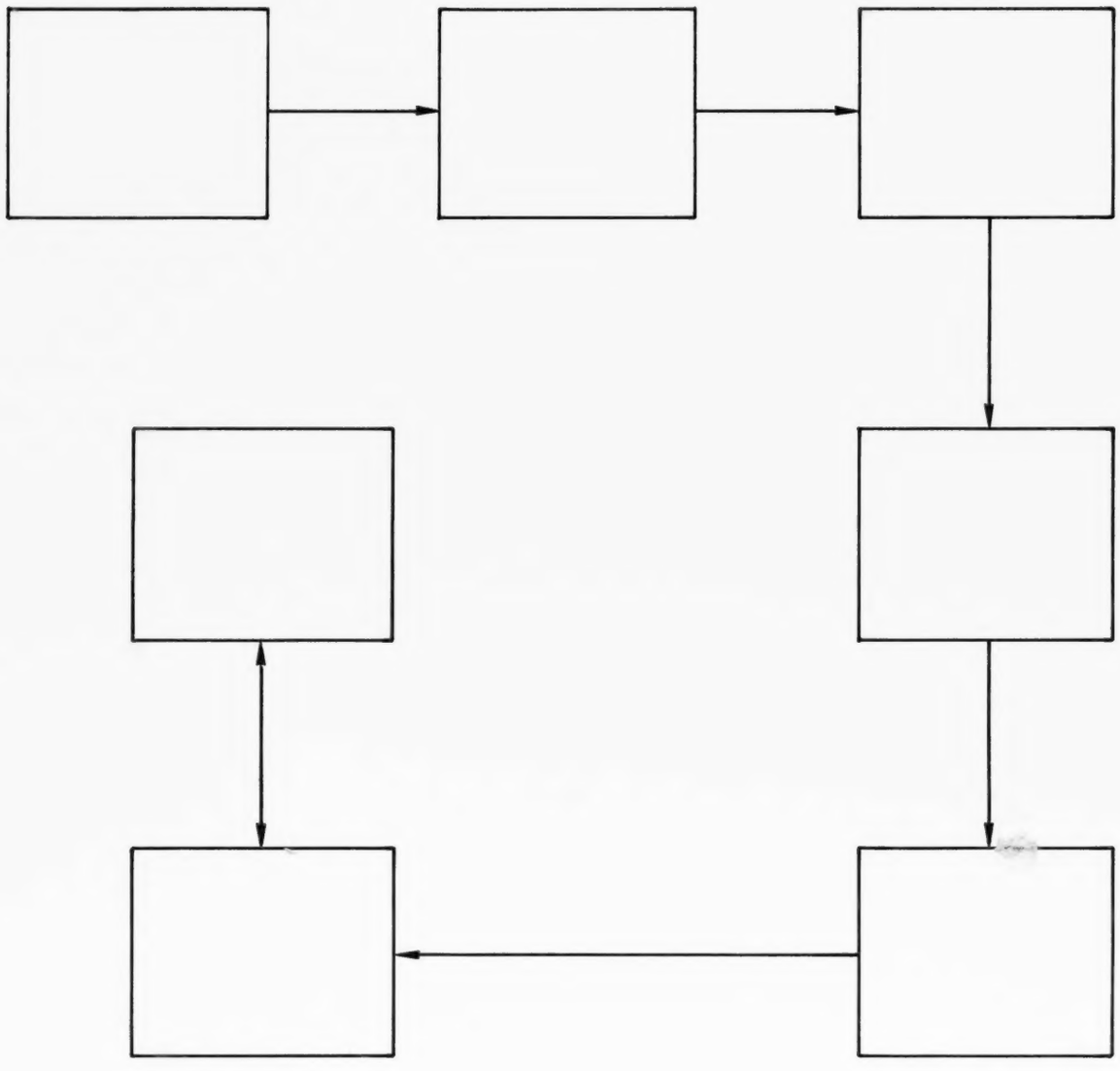
   B. _____

   _____

_____

NOTES:

Flow Chart



Summarize the following:

1. What is the primary advantage in determining student entry level? _____

2. Describe one method for determining entry level. _____

3. How do you adjust an existing course if you find that entry level assumptions are:
   Too high? _____
   Too low? _____

NOTES:

UNIT SIX

SUMMARY

Two kinds of information are needed in order to design a course of instruction. First, the course performance requirements must be specified. Second, the entry level skills must be established.

The course performance requirements describe terminal performance – that is, what the student must be able to do at the end of the course; the objectives specifying these skills comprise the course objectives. By entry level, we mean the relevant knowledge and skills that the student brings with him to the course of instruction. Entry level capabilities will affect the course objectives since these skills need not be taught. Entry level skills can be determined by giving the students an entry level test.

If we design a course on the basis of untested entry level assumptions, we may either underestimate or overestimate the students' capabilities. If we underestimate, we will teach unnecessary course objectives. If we overestimate, objectives essential to the course will be omitted.

Determining actual entry level allows us to design a course with more precision. We can adjust the course objectives, adding or deleting objectives as necessary.

UNIT SEVEN

OBJECTIVES

1. The student will name the two design documents used in developing an entry level test.

2. Given three entry level profiles, the student will describe the entry level of each in relation to the course.

3. Given guidelines, the student will develop a "student contract" as one method of individualizing instruction.

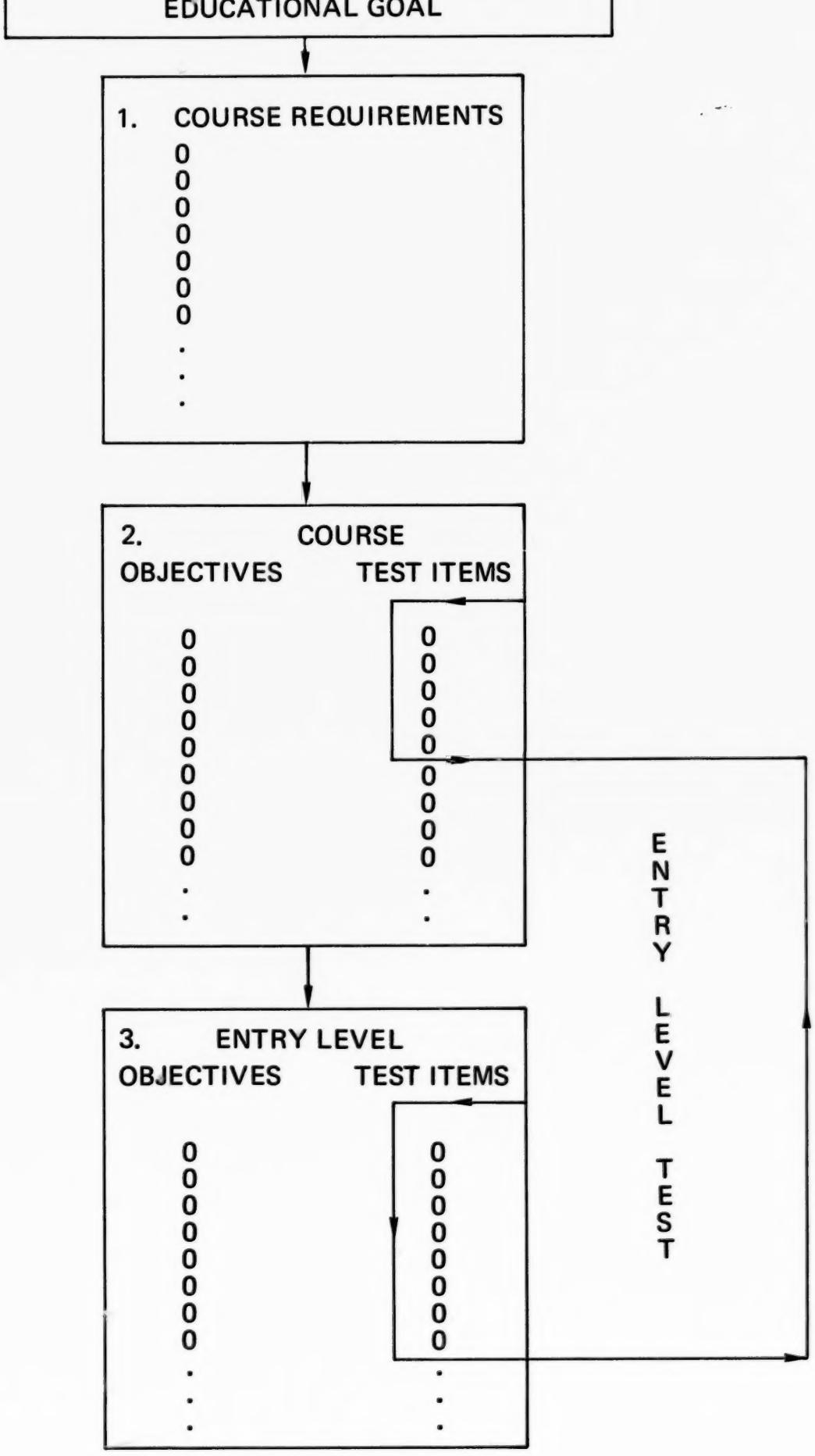
UNIT SEVEN

1. Name the two design documents that are used in developing an entry level test.

   A. _____

   B. _____

NOTES:


EDUCATIONAL GOAL
1. COURSE REQUIREMENTS
2. COURSE OBJECTIVES
TEST ITEMS
3. ENTRY LEVEL OBJECTIVES
TEST ITEMS
ENTRY LEVEL TEST

1. How are course objectives adjusted if we have:

   A. Overestimated student entry level? _____

   _____

   _____

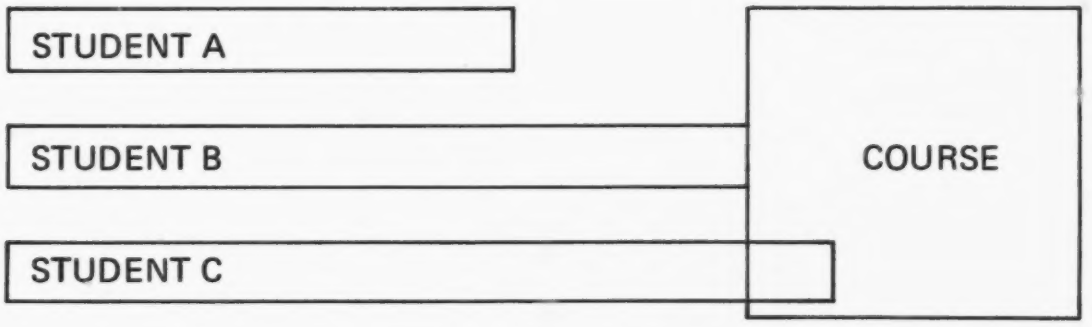
   B. Underestimated student entry level? _____

   _____

   _____

   _____

2.



3. The existing course or tentative course design is represented by the box labeled "COURSE." Describe the entry level capability of each of the three students in relation to the course itself.

   Student A _____

   Student B _____

   Student C _____

Contract #1A MATHEMATICS – Fractions and Mixed Numbers

STUDENT CONTRACT

Purpose

1. To identify proper fractions, improper fractions, and mixed numbers.
2. To compare fractions by means of a number line, thus discovering equivalents and relationships.
3. To obtain practice in division when remainders are to be written in fractions.

Objectives

1. Given a list of fractional units, the student will be able to select all improper fractions, proper fractions, and mixed numbers.
2. Given a list of proper fractions, improper fractions and mixed numbers, the student will be able to place them on a number line and explain their relationships.
3. Given ten division problems, the student will be able to write the remainders in fraction form.

Sample Test Situations

1. From the following list, select all proper fractions, improper fractions, and mixed numbers. In the space provided mark (PF) for proper fraction, (IPF) improper fraction, and (MN) for mixed number.
2. Here are ten number lines showing the distance from 0 to 1. Mark the fractional parts (1/2, 1/4, 1/8, 1/16, 1/3, 1/6, 1/12, 1/5, 1/10).

(cont. on page 47)

Contract #1A MATHEMATICS – Fractions and Mixed Numbers

Sample Test Situations (cont.)

3. Solve the following ten division problems and write the remainders in fraction form.

Activities

1. The student will collect and bring to class recipes containing fractions.
2. The student will prepare a number line for classroom display.
3. The student will prepare circles, squares, and other units to show fractional parts.
4. Others . . . .

Resources

1. Written material
   - A. Math. Reference Book 5 – Chapters V and VI
   - B. Enrichment Book 5 – Chapters IV, V, and VI
   - C. Filmstrip #_____
   - D. Others _____

STUDENT'S NAME _____

ONE WEEK CONTRACT _____

CONTRACT DATE _____ TO _____

(date "contract" received) (date "contract" completed)

Contract # _____ Subject Matter Area _____

STUDENT CONTRACT

Purpose (what the student can expect to gain from the area of study)

Objectives (what the student will be able to do)

Sample Test Situations (these questions are based on the standards and conditions of the criterion performance)

Activities (suggested activities based on principles that allow the student to produce, alter, or use ideas that go beyond existing structures or principles of which he is aware – the student may want to develop this area)

Resources (various instructional means – printed material, films, tapes, records, etc. – that may be used to help the student achieve the criterion performance)

STUDENT'S NAME _____

LENGTH OF CONTRACT _____ (suggested length – one week)

CONTRACT DATE _____ TO _____

(date "contract" received) (date "contract" completed)

UNIT SEVEN

SUMMARY

An entry level test, even when given to a sample of only thirty students, will reveal that few of them have precisely the same entry level skills. The sample diagram on page 44 of the workbook illustrates how varied entry level can be.

Unit Seven provides a number of suggestions on how to adapt to a situation in which some students surpass, some fall short of, and others meet the assumed entry level of a course of instruction. An instructor's main concern should be that each student achieve the necessary course objectives, regardless of his entry level skills.

There are a number of different ways to deal with the problem of varied entry levels. You might provide a remedial course for students who fall below assumed entry level, let the more advanced students by-pass certain areas of the instruction, or develop an individualized program using student "contracts."

UNIT EIGHT

OBJECTIVES

1. The student will define "overt behavior," "covert behavior," and "overt indicator."

2. The student will discriminate which of the following are normally overt: verbal, verbal background, motor performance, discrimination.

3. The student will discriminate whether the stimuli or the responses are identified first.

4. The student will explain why the stimuli are identified.

5. Given a task description, the student will identify the stimuli and the responses.

6. The student will classify given stimulus-response pairs as verbal, discrimination, motor performance, or a combination of these.

7. The student will develop subobjectives from given stimulus-response pairs, and classify them as verbal, discrimination, motor performance, or a combination of these.

UNIT EIGHT

1. Define:

   A. "overt behavior" _____

   _____

   B. "covert behavior" _____

   _____

   C. "overt indicator" _____

   _____

2. When observing a student carrying out a series of tasks, which of the following would be overt behavior?

   _____ A. Verbal performance or its consequence

   _____ B. Motor performance

   _____ C. Verbal background

   _____ D. Discrimination

3. When analyzing performance requirements, which would we try to identify first?

   _____ A. The stimuli _____ B. The responses

4. Why do we have to identify stimuli? _____

   _____

   _____

Task Description

Before inserting a mimeograph stencil in the typewriter to type a stencil, the student must clean the type keys or type ball with a cleaning brush and typewriter cleaning fluid. He then sets the touch control (usually at number 3). Finally, he should set the ribbon control on "stencil." The attached end of the mimeograph stencil is inserted into the typewriter first, and the plastic film side should face the typist. With mimeograph stencil in position the student will type stencil.

Objective

Given the necessary instructions, the student will type a mimeograph stencil.

	Stimulus		Response
1.	_____	1.	_____
2.	_____	2.	_____
3.	_____	3.	_____
4.	_____	4.	_____
5.	_____	5.	_____
6.	_____	6.	_____

Task Description

Before inserting a mimeograph stencil in the typewriter to type a stencil, the student must clean the type keys or type ball with a[1] (cleaning brush and typewriter cleaning fluid.) He then sets the[2] (touch control) (usually at number 3). Finally, he should set the[3] (ribbon control) on "stencil." The[5] (attached end of the mimeograph stencil) is inserted into the typewriter first, and the[4] (plastic film side) should face the typist. With[6] (mimeograph stencil) in position, the student will type stencil.

Objective

Given the necessary instructions, the student will type a mimeograph stencil.

	Stimulus		Response	Class	
1.	Cleaning brush and typewriter cleaning fluid	1.	Clean type keys or type ball	[ ]	[ ]
2.	Touch control	2.	Set touch control at #3	[ ]	[ ]
3.	Ribbon control	3.	Set ribbon control on "stencil"	[ ]	[ ]
4.	Plastic film side of stencil	4.	Plastic film facing typist	[ ]	[ ]
5.	Attached end of mimeograph stencil	5.	Insert attached end into typewriter	[ ]	[ ]
6.	Mimeograph stencil in position	6.	Type stencil	[ ]	[ ]

Objective: Given the necessary instructions, the student will type a mimeograph stencil. (MP)

Directions: From the six stimulus-response pairs and their classifications, write six subobjectives with "matching" performance requirements. Indicate the subobjective classification.

1. Given a cleaning brush and typewriter cleaning fluid, the student will clean the type keys or type ball. (D) (MP)

2. The student will locate the touch control and set it at #3. (D)

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

_____

_____

NOTES:

UNIT EIGHT

SUMMARY

Verbal background may be defined as any behavior that would be of assistance in prompting performance (motor, verbal, or discrimination performance). Verbal background is most often associated with "telling yourself how" to do something; thus you are prompting the performance you will carry out.

Behavior is the continuous flow of activities, and a response is a meaningful unit of behavior. A stimulus is the instigator of a response, and the consequence of a response acts as feedback for the next response in the flow of behavior.

Response that can be readily observed, such as those involved in motor and verbal performance, are termed overt. Covert responses cannot be observed. Discrimination is covert, and verbal background usually involves covert responses. Almost any task involves both overt and covert responses.

When we analyze performance, we first identify the response; and then we identify the stimulus so that we can teach the student to respond to it.

One important use of stimulus-response (S-R) pairs is in the development of course objectives. By identifying the S-R pairs involved in a broad, general objective, we can break it down into smaller steps or subobjectives.

UNIT NINE

OBJECTIVES

1. Given a task description and general objective, the student will develop S-R pairs; classify each S-R pair as D, MP, V, or a combination of these; and derive subobjectives from the S-R pairs.

2. The student will explain the difference between one-way and two-way S-R pairs.

3. The student will explain the difference between single and multiple discrimination.

UNIT NINE

Task Description

The student will take a driver's training course to learn how to drive a car safely. The course is administered by an instructor in a car with an automatic transmission. Some of the tasks he will be expected to perform correctly are the following: when approaching a stop sign, press down on the brake pedal. Having stopped the car, check to see that no cars are approaching. Then accelerate smoothly. When desirous of turning left at an intersection, and on approaching intersection, turn on left-hand turn signal. Having reached the intersection, turn left. When told to do so, operate the switches that turn on and off the lights, windshield wipers, and defroster.

Objective: The student will drive safely.

	Stimulus		Response		Class
1.	Stop sign	1.	Press down on brake pedal	1.	MP/D
2.	No cars approaching	2.	Accelerate smoothly	2.	MP/D
3.	_____	3.	_____	3.	____
4.	_____	4.	_____	4.	____
5.	_____	5.	_____	5.	____
6.	_____	6.	_____	6.	____
7.	_____	7.	_____	7.	____

Task Description

The student will take a driver's training course to learn how to drive a car safely. The course is administered by an instructor in a car with an automatic transmission. Some of the tasks he will be expected to perform correctly are the following: when approaching a stop sign, press down on the brake pedal. Having stopped the car, check to see that no cars are approaching. Then accelerate smoothly. When desirous of turning left at an intersection, and on approaching intersection, turn on left-hand turn signal. Having reached the intersection, turn left. When told to do so, operate the switches that turn on and off the lights, windshield wipers, and defroster.

Objective: The student will drive safely.

	Stimulus		Response		Class
1.	Stop sign	1.	Press down on brake pedal	1.	MP/D
2.	No cars approaching	2.	Accelerate smoothly	2.	MP/D
3.	Approaching intersection	3.	Turn on left-hand turn signal	3.	D
4.	Reached intersection	4.	Turn left	4.	D/MP
5.	Turn light on	5.	Operate light switch	5.	D
6.	Turn wipers on	6.	Operate wiper switch	6.	D
7.	Turn defroster on	7.	Operate defroster	7.	D

Objectives

1. When approaching a stop sign, the student will correctly and safely press down on the brake pedal and come to a stop.

2. Having stopped the car, the student will visually check cross traffic before proceeding, then accelerate smoothly.

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

_____

7. _____

_____

Objectives

1. When approaching a stop sign, the student will correctly and safely press down on the brake pedal and come to a stop.

2. Having stopped the car, the student will visually check cross traffic before proceeding, then accelerate smoothly.

3. When approaching an intersection intending to make a left turn, the student will turn on the left-hand turn signal.

4. Having reached the intersection, the student will correctly and safely turn left.

5. When told to turn lights on, the student will operate the light switch.

6. When told to turn the wipers on, the student will operate the wiper switch.

7. When told to turn on the defroster, the student will operate the defroster.

		Stimulus	Response
1.	a.	Who was the Union commander at the battles of Vicksburg, Shiloh and Appomattox?	U.S. Grant
	b.	Name the three battles at which U.S. Grant was the commander.	Vicksburg, Shiloh, and Appomattox
2.	a.	When was the Declaration of Independence adopted by the Continental Congress?	July 4, 1776
	b.	What happened on July 4, 1776?	The Declaration of Independence was adopted by the Continental Congress.
3.	a.	Name the five major parts of a cell.	Cell membrane, cytoplasm, nucleus, nuclear membrane, and nucleoplasm.
	b.	Diagram of a cell.	(Labels the five major parts.)

One-way	(1)	X⟶Y	(We can't be sure that if given Y, the student can respond with X.)
	(2)	Y⟶X	(Don't teach X⟶Y.)
Two-way	(1)	X⟶Y Y⟶X	(If both responses are required, teach both.)

1. Explain the difference between one-way and two-way stimulus-response pairs.

2.

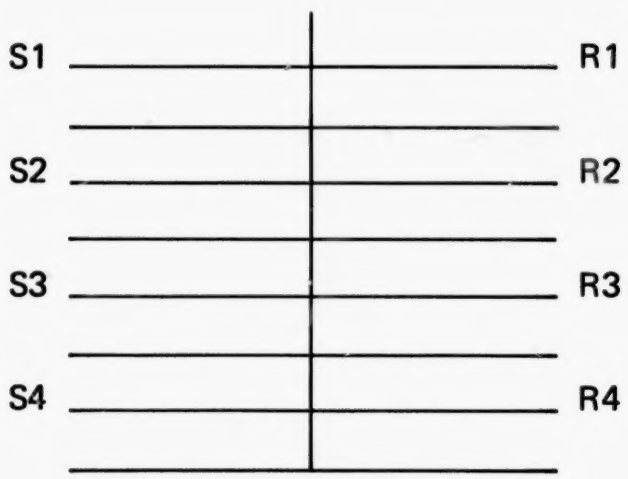
fat cell

nerve cell

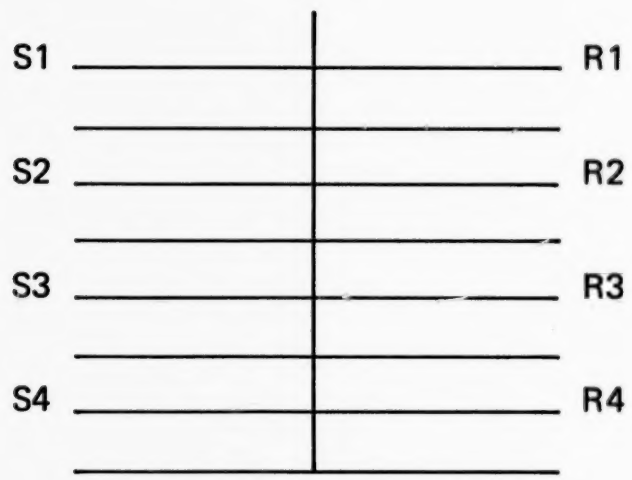
epithelial cell

smooth muscle cell

single discrimination



multiple discrimination



1. Explain the difference between single and multiple discrimination.

2.

	Stimulus	Response	Class
1,	"Name?" (picture of fat cell)	"Fat cell"	V
2.	"Which of the following pictures is the picture of a fat cell?"	Identifies fat cell by pointing to it.	D
3.			
4.			
5.			
6.			
7.			
8.			

2.		Stimulus	Response	Class
	3.	"Name?" (picture of nerve cell)	"Nerve cell"	V
	4.	"Which of the following is the picture of a nerve cell?"	Identifies nerve cell by pointing to it	D
	5.	"Name?" (picture of epithelial cell)	"Epithelial cell"	V
	6.	"Which of the following is the picture of an epithelial cell?"	Identifies epithelial cell by pointing to it	D
	7.	"Name?" (picture of smooth muscle cell)	"Smooth muscle cell"	V
	8.	"Which of the following is the picture of a smooth muscle cell?"	Identifies smooth muscle cell by pointing to it	D

UNIT NINE

SUMMARY

Because the entire unit is spent on practice exercises in the workbook, there are no visuals for Unit Nine. This unit reviews the development and classification of S-R pairs and the derivation of subobjectives from S-R pairs. It also discusses one-way and two-way S-R pairs, and single and multiple discriminations.

While performing a task, the student attends to a stimulus and then makes the required response. This is a one-way S-R pair. In a two-way S-R pair, not only does the task require that the student attend to a stimulus and make the appropriate response, but also that he respond with a model of the stimulus when given a model of the response.

One-way S-R pairs should be carefully distinguished from any two-way S-R pairs. If a two-way S-R pair is encountered, the required behavior must be specifically taught in both directions; it is not sufficient to assume that if one direction is taught, the other is learned automatically. If a one-way S-R pair is encountered, the reverse behavior should not be taught; it is inefficient to teach any behavior if the task does not require it.

We should also distinguish between single and multiple discriminations. A single discrimination requires that given a number of objects or situations, the student discriminate the one that is appropriate. A multiple discrimination requires that given a number of objects or situations, he discriminate each of them. With a single discrimination, only one response is appropriate, and it is appropriate to only one of the objects or situations. With a multiple discrimination, each object or situation requires its own response, which is appropriate to it alone.

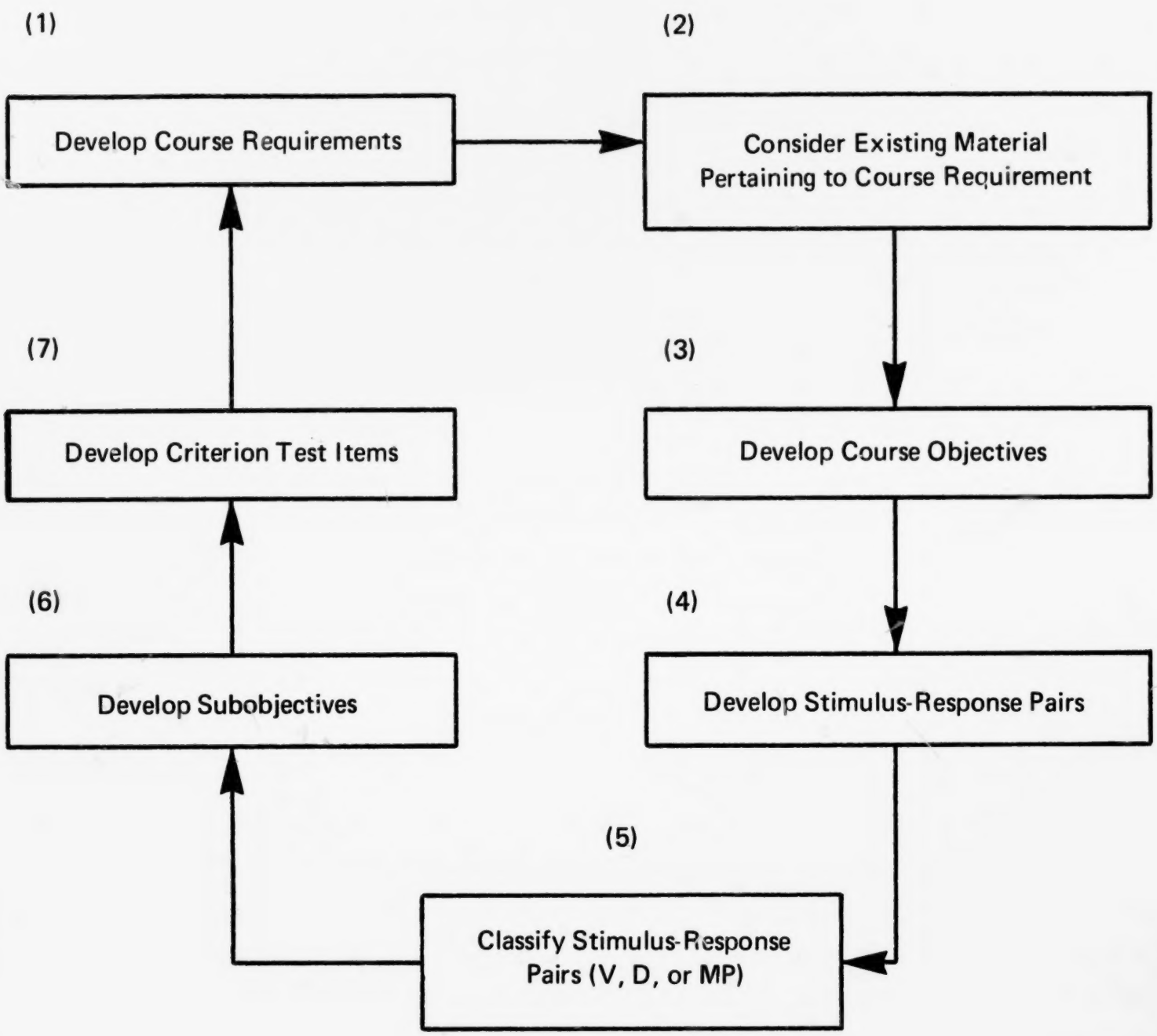
UNIT TEN

OBJECTIVES

1. Given content material and the necessary guidelines, the student will develop a course blueprint (S-R pairs, objectives, and criterion test items).

CONTENT ANALYSIS

FLOW CHART



UNIT TEN

OBJECTIVE: GIVEN A PUNCH CARD CONTAINING BOTH ZONE AND DIGIT PUNCHES, AND WITHOUT USING ANY REFERENCE MATERIALS, THE STUDENT WILL CORRECTLY IDENTIFY AND WRITE EACH LETTER, DIGIT, AND PUNCTUATION MARK REPRESENTED.

INTRODUCTION

Beginning on this page is a narrative, which outlines the alphanumerical system used on punch cards. You are to read this narrative and prepare a course blueprint: an S-R table, instructional objectives, and a criterion test to accompany the broad objective stated above. All of this content can be classified as part of the objective, or as enrichment, or as irrelevant. You should begin by identifying the parts of the objective.

CONTENT

READING PUNCH CARDS

Originally punch cards were used only for business and scientific records. Now we see punch cards used for many other purposes. Salary checks, income tax forms, utility bills, and even savings bonds are printed on punch cards. The punch cards most commonly seen have rectangular holes, although some cards have round holes. Punch cards are correctly termed "Hollerith cards," but you rarely hear them called that.

A typical punch card is divided into eighty vertical columns. Reading from left to right, the columns are numbered from 1 to 80. Look at Figure 1 on page 73. The column numbers are printed in two locations, indicated by the arrows. Unless human eyes have to locate a specific column, it is not essential that these numbers appear on the card. Within each column there are twelve punching positions, which form horizontal rows across the card. Look at Figure 1 on page 73. Ten of these rows are numbered, 0-9, with row 9 at the bottom of the card. There are two additional rows above the zero row. The row immediately above zero is called row 11, and the top row is row 12. Rows 11 and 12 are not numbered on the card. In Figure 1, however, the numbers are shown in the upper left corner of the card to indicate the location of rows 11 and 12. To summarize, a punch card is divided into eighty columns, and there are twelve rows within each column. Reading from top to bottom, the rows are numbered: 12, 11, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Figure 1

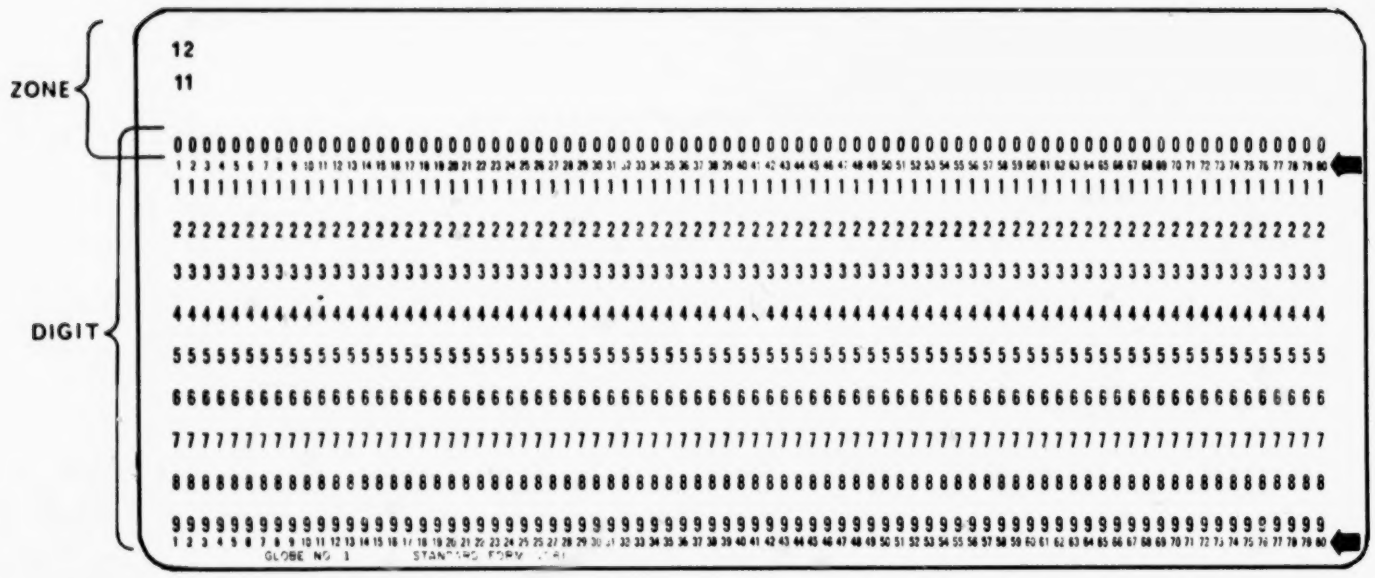


Figure 2

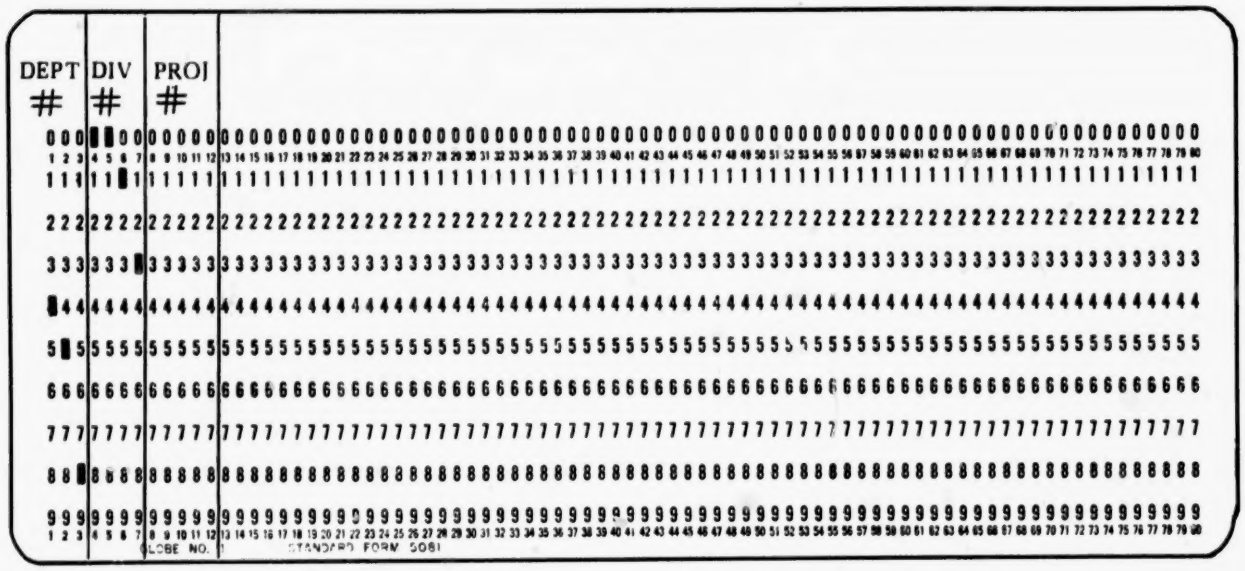


Figure 1

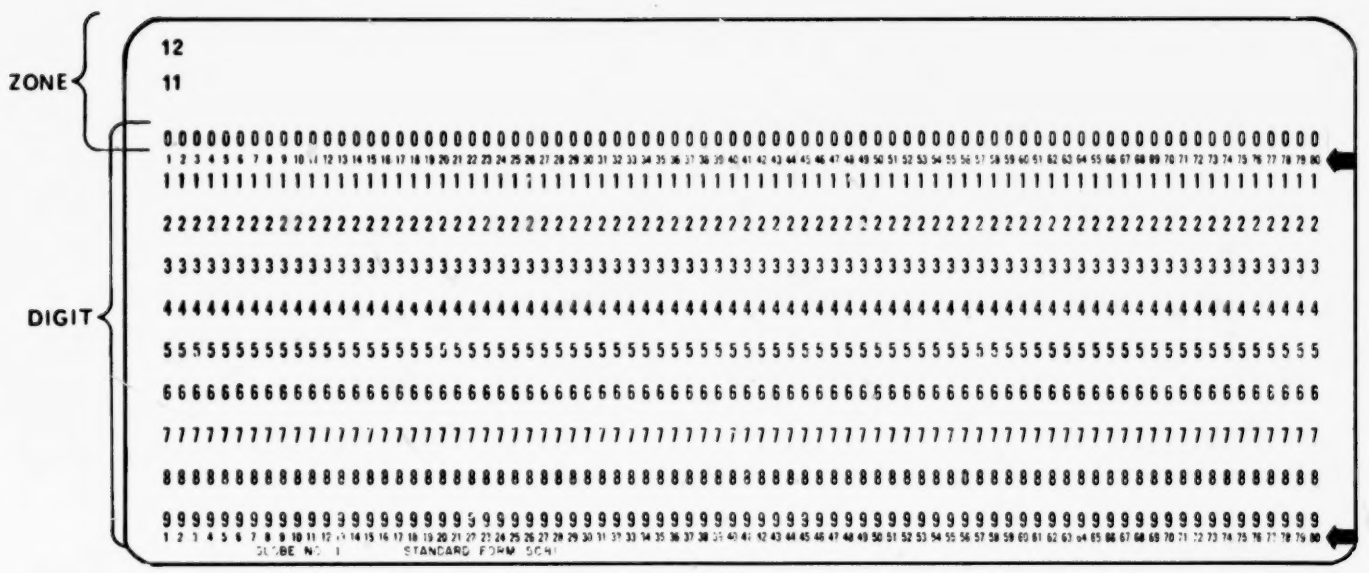
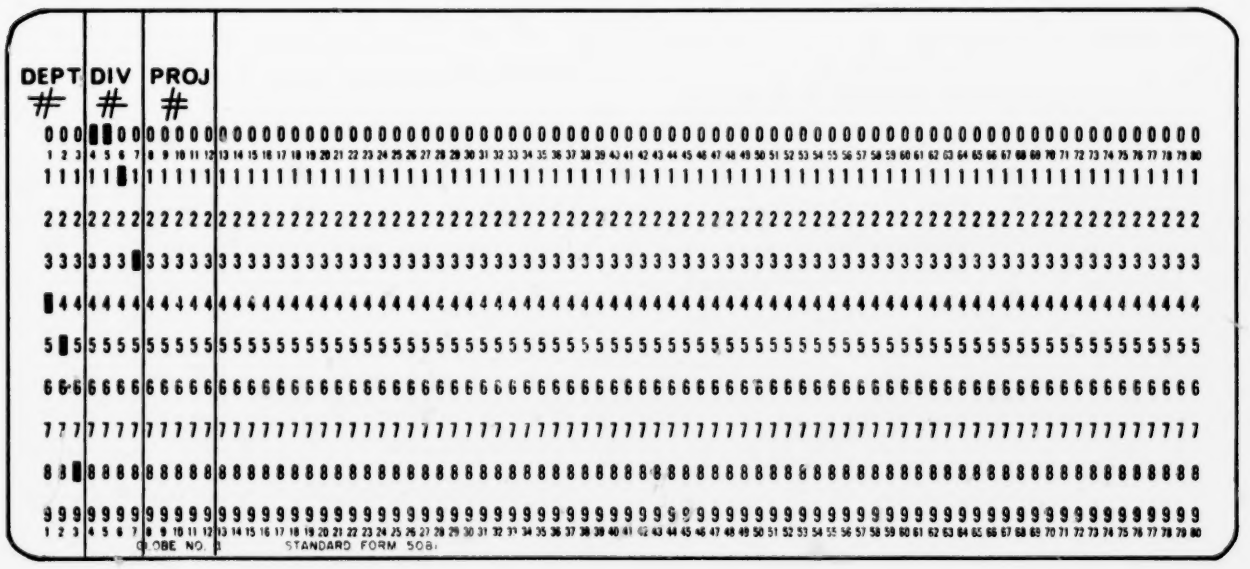


Figure 2



Look at Figure 1 on page 74. Rows 0-9 make up the digit portion of each column, and a punch in any of these rows is called a "digit punch." Rows 12, 11, and 0 make up the zone portion of the column, and a punch in these three rows is called a "zone punch." Notice that the two portions overlap; the zero row is considered to be part of both the digit portion and the zone portion. Consequently a punch in the zero row may be either a digit punch or a zone punch. This will be explained below.

A single digit punch in a column represents a digit: 0-9. Two punches in the same column indicate a letter of the alphabet. One of these punches is always a zone punch (0, 11, 12) and the other is always a digit punch (1-9). The dual use of the zero row should now be clear. When a zero punch is the only punch in a column, it is a digit punch and represents zero. When there are two punches in the same column – zero and some other digit – a zero punch is a zone punch, and the combination represents a letter of the alphabet. It is important to note that zone punches 11 and 12 are not used to designate numbers. The zero is used to represent zero, but the 11-zone and 12-zone punches are not used for 11 and 12. The three zone punches – 0, 11, 12 – are used for other purposes, primarily in designating letters of the alphabet.

Letters A through I use a 12-zone punch and one of the 1 through 9 digit punches. For example, the 12-zone punch and the 1 digit punch would be the letter A. The 12-zone punch and the 2 digit punch would be B, 12 and 3 would be C, and so on, until 12 and 9 would be I.

Letters J through R use an 11-zone punch and one of the 1 through 9 digit punches. The letter J would be 11 (zone punch) and 1 (digit punch), and so on, until the 11-zone punch and 9 digit punch would be R.

Letters S through Z use a 0-zone punch and one of the 2 through 9 digit punches. Unlike previous cases of the 12-zone and 11-zone punches using the 1 digit punch, the 0-zone punch begins with the 2 digit punch. This is because early punch card "machines" could not sense two punches in the same column that close together (zero and 1). Therefore they decided to skip a number and start the S through Z alphabet with the 2 digit punch rather than the 1 digit punch.

In many cases punch cards have printing on them to designate specific information. For example, the first three columns may be blocked off by a vertical line to the right of column 3 and labeled Department Number (Dept. #), as shown in Figure 2. Holes can then be punched in the three columns to indicate the department number, such as Department 458 (4 punched in first column, 5 in the second column, and 8 in the third column). This is shown in Figure 2. When columns are blocked off in this manner, the block is known as a "field." Blocking off the columns as we want, we can then find various kinds of information within each field.

A field, then, is a group of adjacent columns. The technical term for a field reserved for numeric information is "numeric field." A field reserved for alphabetic information is an "alphabetic field."

When reading a numeric field, you should pay no attention to zeros if such zeros begin the field. It is common practice to punch every column in a numeric field. Look at Figure 2. The Division Number (Div. #) in the numeric field consisting of columns 4, 5, 6 and 7 is Division 13. Consequently a zero is punched in columns 4 and 5, a 1 in column 6, and a 3 in column 7.

Here are some final points. When a column in an alphabetic field is not punched, it is read as a blank. This allows you to leave a space between words. In a date field, days are usually two columns: 07 is the 7th, 23 is the 23rd, etc. Years are punched in two columns (62 for 1962) or one column (2 for 1962). Any month of the year can be punched in a single column because there are twelve rows available: January through September as digits 1-9, October as 0-zone punch, November as 11-zone punch, and December as 12-zone punch.

Additional information can be indicated such as plus and minus accounts. A numeric field with a 12-zone punch over one of the columns would indicate a plus amount. A numeric field with an 11-zone overpunch would indicate a minus amount. Thus monetary sums can be indicated as credits or debits.

Figure 1

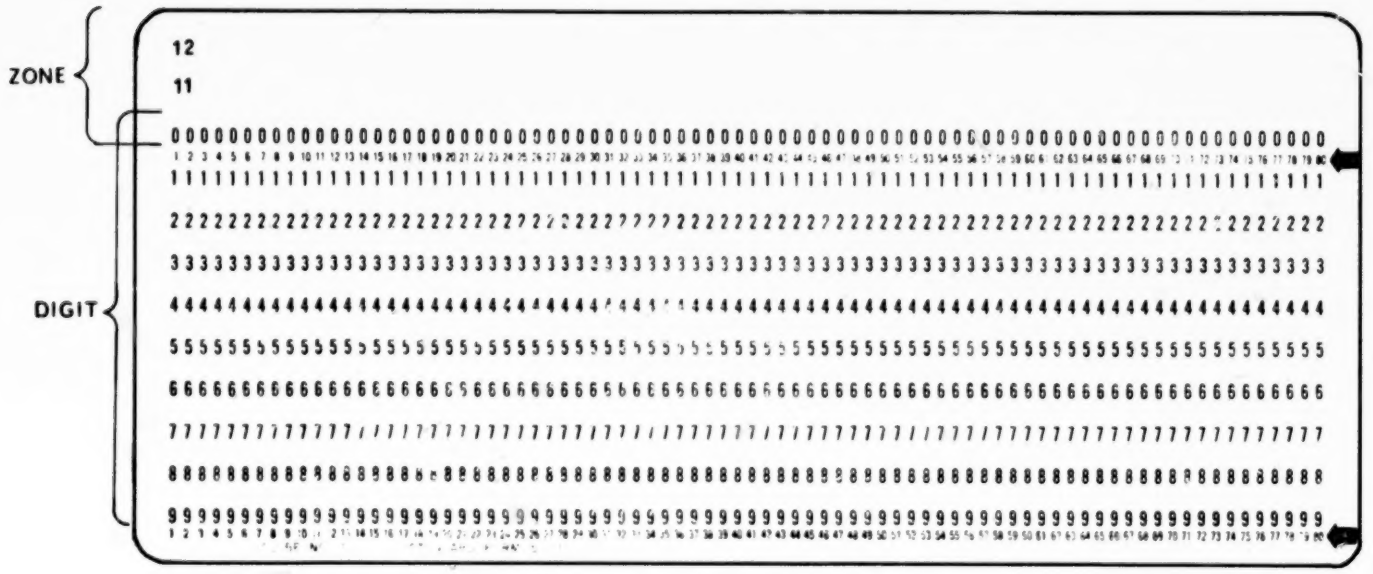
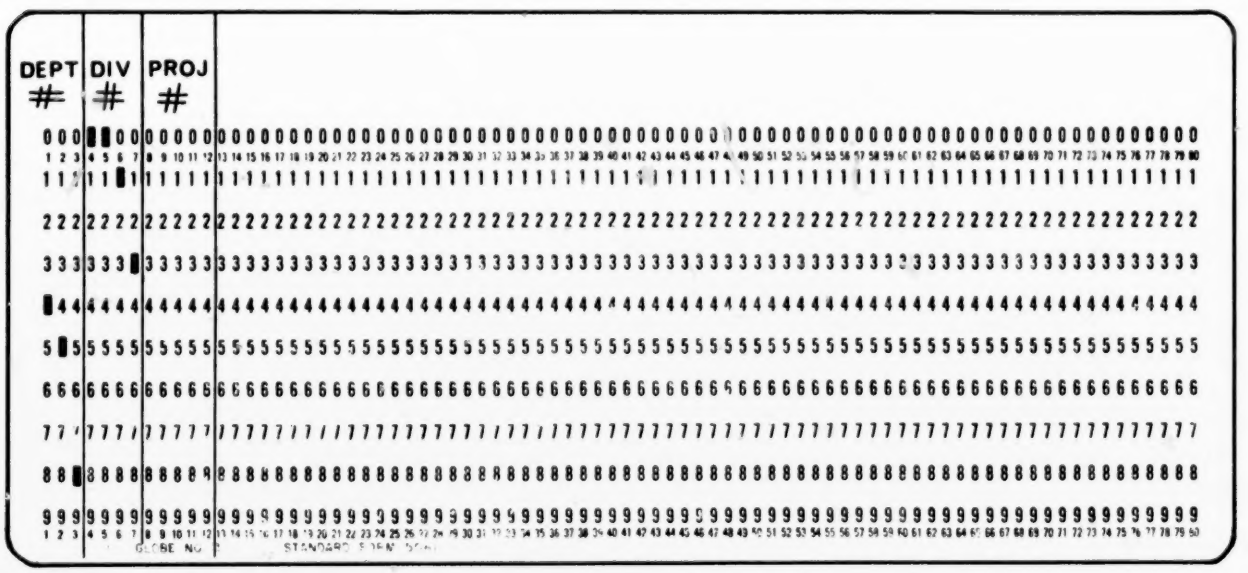
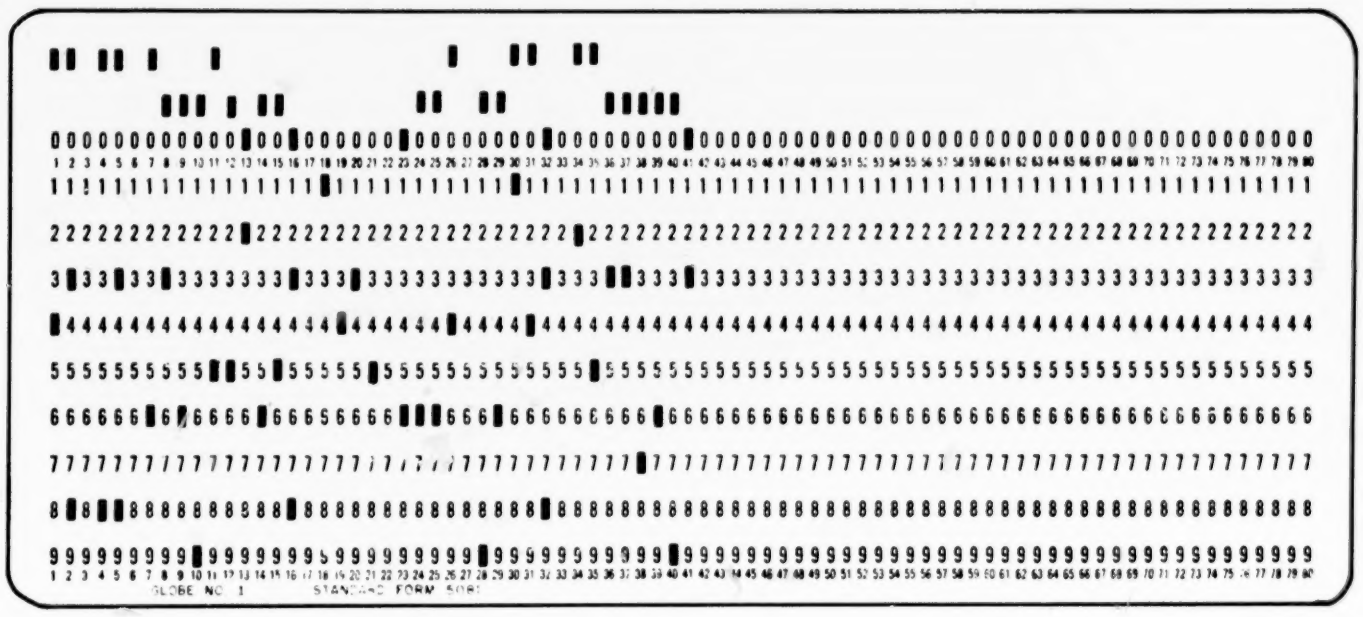


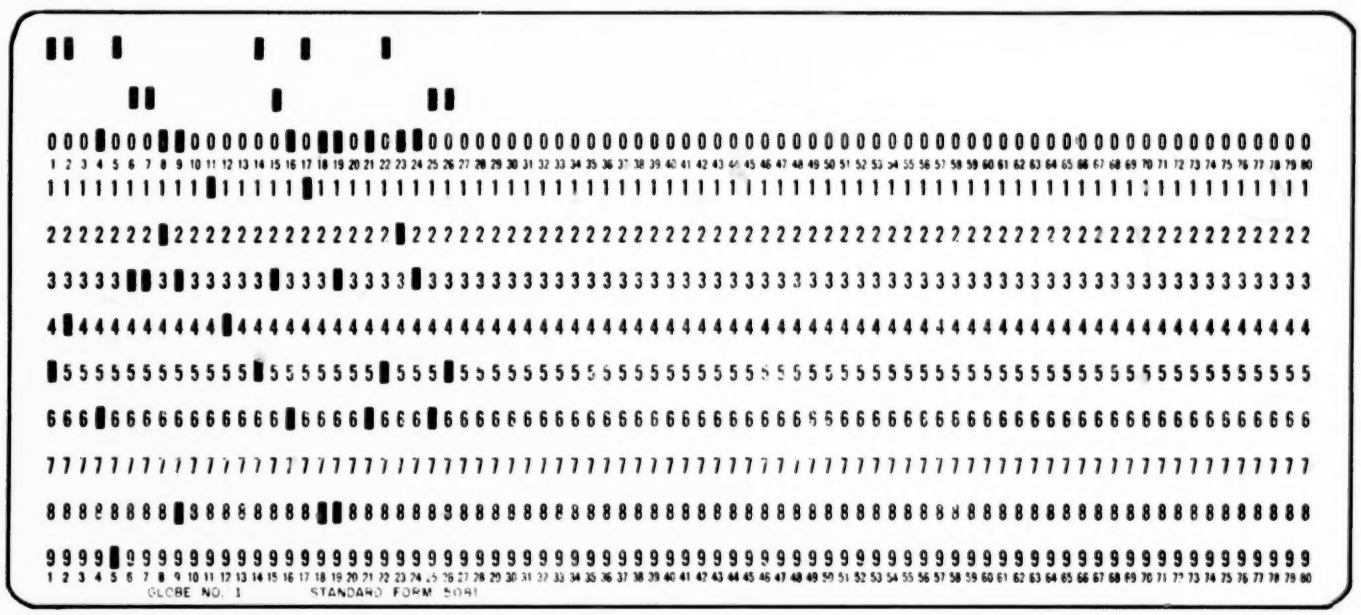
Figure 2



A



B



Card A

Card B

STIMULUS-RESPONSE TABLE

Stimulus	Response	Class
1.	1.	
2.	2.	
3.	3.	
4.	4.	
5.	5.	
6.	6.	
7.	7.	
8.	8.	
9.	9.	
10.	10.	
11.	11.	
12.	12.	
13.	13.	

Stimulus	Response	Class
1. How many card columns are there on a standard punch card?	80 card columns	V
2. How many rows?	12 rows	V
3. How are the rows identified, and how are they arranged?	Identified by numbers from zero to 12, from top of card: 12, 11, 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.	V
4. What are the two names given to punches in the two parts of each column, and what are their locations?	Zone punches, in the 0, 11, and 12 rows Digit punches, in the 0 through 9 rows	V
5. Where and how are numbers represented on a punch card?	By digit punches, rows 0 through 9, one punch per column	V
6. How many punches are used to represent letters, and where?	Two per column, a zone punch plus a digit punch	V
7. When is a zero a zone punch, and when is it a digit punch?	Digit punch when only punch in column; zone punch when another punch in same column	D
8. What letters are represented by a 12-zone punch plus a digit punch?	A through I	V
9. By an 11-zone punch plus a digit punch?	J through R	V
10. By a 0-zone punch plus a digit punch?	S through Z	V
11. What is the exception to the regular alphabetic pattern of zero plus digit punches?	The 0 and 1 combination is not used; S is 0 plus 2	V
12. How many punches are used to represent a comma and a period, and where?	Three per column, one zone punch plus two digit punches	V
13. Given sample card a. single punch in rows 0-9 b. zone punch plus digit punch c. zone punch plus two digit punches	Correctly reads letters and numbers a. writes correct digit b. writes correct letter c. writes correct punctuation mark	V/D

INSTRUCTIONAL OBJECTIVES (based on S-R PAIRS on page 81)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

CRITERION TEST ITEMS (based on instructional objectives on page 83)

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

UNIT TEN

SUMMARY

Unit 10 is an introduction to content analysis designs and procedures. The design documents that are prepared (S-R table, objectives, and criterion test items) make up the course blueprint specifying the desired result of instruction and the design on which it is based. When developing the course blueprint, all documents are response-oriented.

A content analysis flow chart can be used as a guide when developing the course objectives, S-R units, subobjectives, and criterion test items.

In this unit, the student is instructed in the reading of both alphabetical and numerical information on standard punch cards.

The student is taken through the procedures step-by-step and given practice exercises during the instruction, then develops the three components of a course blueprint from the punch card content material.

UNIT ELEVEN

OBJECTIVES

1. Given a specific response, the student will identify the stimulus that instigated the response.

2. The student will explain how "scanning" and "matching" are involved when answering a multiple-choice question.

3. Given a list of ten brief descriptions of activities, the student will identify the statements that involve a chain.

4. Given a series of illustrations depicting chain activities, the student will construct an S-R table.

1. A student stops working and goes to a reference book. He looks in the index, finds a page reference, turns to that page, reads part of it, then returns to his work. What was the stimulus that caused the response, Goes to reference book?_____

_____

_____

2. When you answer a multiple choice question, you are scanning and matching. Explain:_____

_____

_____

3. Example of a chain: Student will light a bunsen burner.

Stimulus	Response	Consequence
1. "Light bunsen burner"	1. Strikes match	1. Match lit
2. Lit match	2. Opens gas valve	2. Valve open
3. Gas valve open	3. Lights bunsen burner (dispose of match)	3. Yellow flame
4. Yellow flame	4. Adjusts air	4. Blue flame

4. Which of these are "chains?"

_____ A. Man strikes match, lights his pipe.

_____ B. Woman puts on hat, then coat.

_____ C. Woman burns food, throws it away.

_____ D. Man turns on radio, starts to read.

_____ E. Man starts engine, adjusts throttle.

_____ F. Woman sips tea, starts to write.

_____ G. Boy throws ball, sits down.

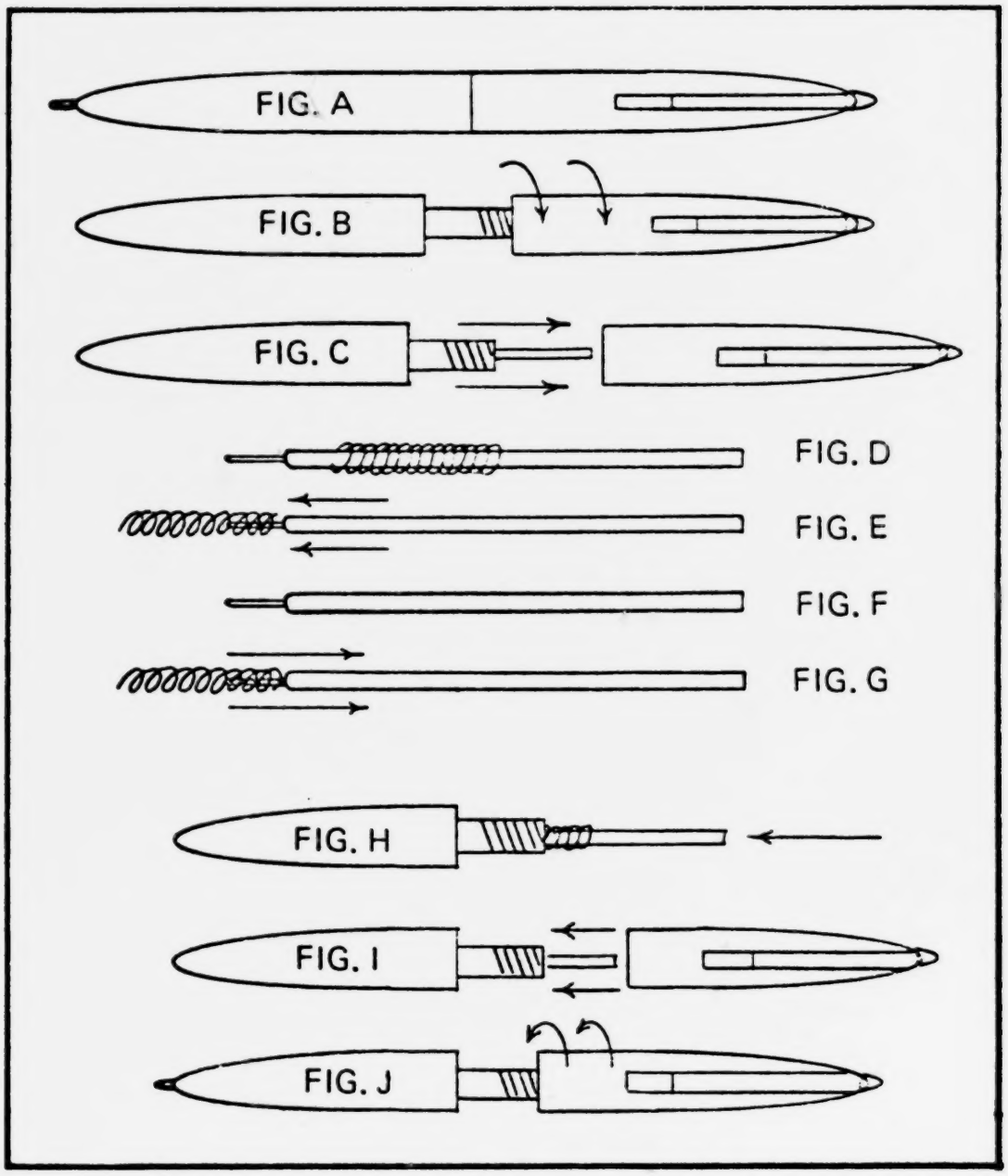
_____ H. Light turns red, driver stops car.

_____ I. Man writes name.

_____ J. Woman looks in index, turns to page 9.

NOTES:

5. Describe the difference between a chain and a sequence that is not a chain.



STIMULUS-RESPONSE TABLE

Stimulus	Response	Consequence
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
8.	8.	8.
9.	9.	9.
10.	10.	10.

STIMULUS-RESPONSE TABLE

Stimulus	Response	Consequence
1. Pen needing new cartridge	1. Unscrew cap	1. Two halves released
2. Two halves released	2. Remove cap	2. Cartridge exposed
3. Cartridge exposed	3. Remove cartridge	3. Cartridge and spring
4. Cartridge and spring	4. Remove spring	4. Separate cartridge and separate spring
5. Separate cartridge and separate spring	5. Discard cartridge	5. Empty cartridge holder
6. Empty cartridge holder	6. Pick up cartridge	6. Bare cartridge and spring
7. Bare cartridge and spring	7. Put spring on ball end of cartridge	7. Spring on cartridge
8. Spring on cartridge	8. Insert cartridge in base of pen point	8. Pen with cartridge in it
9. Pen with cartridge in it	9. Place cap on pen and begin turning	9. Cap can be turned no further
10. Cap can be turned no further	10. Stop turning	10. New cartridge in place

UNIT ELEVEN

SUMMARY

Discrimination involves matching a certain object or situation to a standard. Finding the match may require attending to several objects or situations, either as a group or one after the other. This activity is known as scanning. Attending to each situation or object, scanning the group of them, and matching with the standard are thus basic ingredients of discrimination.

Many tasks consist of a sequence of S-R pairs which must follow in a certain order; otherwise, the task cannot be completed. This is because the consequence of one response acts as the stimulus for the next response; if the consequence does not occur, the next response cannot be made. Such a sequence is called a chain.

UNIT TWELVE

OBJECTIVES

1. Given a content guide, the student will develop general goals.

2. Having written general goals from a content guide, the student will develop behaviorally stated objectives.

3. Having written behaviorally stated objectives based on general goals developed from a content guide, the student will develop relevant subobjectives.

SIMPLE MACHINES – THE LEVER

Scientists have classified machines into two general categories: simple and complex machines. Complex machines are actually combinations of many simple machines. You should recall the definition of machines in terms of helping us to do work.

There are six kinds of simple machines: lever, pulley, wheel and axle, screw, wedge, and inclined plane. It is not so important to worry about how many types of simple machines exist, but rather the function each serves. If you look in some old textbooks you will notice that there used to be a classification of machines into four or five types. This is because certain simple machines, when looked at in a certain way, might be classified together, i.e., inclined plane as a wedge. Today, however, scientists agree that there are six types. Each of these types includes machines of just one kind, according to the characteristics we define for each of them. This should point out to you the importance of having standards in science so that all of us can agree on what we are talking about.

Whenever you use a screwdriver to pry up the lid of a paint can, you are using a lever. You have used many levers such as the wheelbarrow, broom, scissors, and so on. It might appear to you that some of these objects have little in common; but when you study the common characteristics they have, you will see that they are all levers.

In its simplest form, a lever is a long, rigid bar which has a support; it may rest on the support, or it may be supported from above. The support point on the lever is called the fulcrum, and the lever can move around this point. The fulcrum may be at either end of a lever or at any point between the ends.

There are three types of levers. Figure 1.1 shows a first-class lever. The fulcrum (F) can be at any point between the ends of the lever. If you exert effort (E) at one end of the lever a load or resistance (R) at the other end will move. Notice that in a first-class lever, the fulcrum is between the effort and the resistance.

First Class

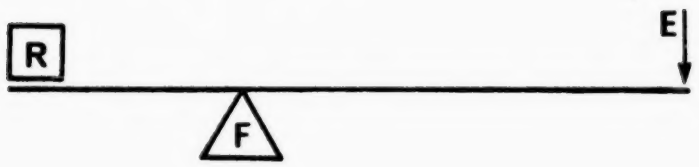


Figure 1.1

Figure 1.2 illustrates a second-class lever. In this type, the resistance is between the fulcrum and the effort.

Second Class

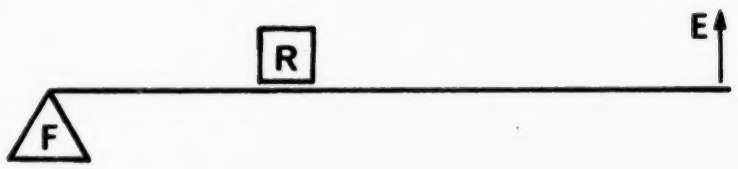


Figure 1.2

Look at Figure 1.3. In a third-class lever, the effort is between the fulcrum and the resistance.

Third Class

Figure 1.3

The distance from the effort to the fulcrum is called the effort arm. The distance from the resistance to the fulcrum is called the resistance arm. By knowing these distances we have a convenient way of estimating the mechanical advantage of the lever. It is only an estimate

because the actual mechanical advantage is somewhat less because of friction. The mechanical advantage is estimated by dividing the effort arm by the resistance arm. Suppose, for example, the effort arm is 20 feet and the resistance arm is 10 feet. The estimated mechanical advantage would then be 2. This means that if you had a 50-pound load on the resistance end, you would have to apply only 25 pounds of effort to the effort load.

The arms of the lever may have different lengths or the same length. When the effort arm is longer than the resistance arm, the mechanical advantage will always be more than 1. In this case, the lever helps by increasing the amount of force. A smaller effort overcomes a larger resistance, but the resistance is not moved as far or as fast as the effort moves.

When the resistance arm is longer than the effort arm, the mechanical advantage is less than 1. The lever helps by increasing the distance and speed of a force. The resistance is moved farther and faster than the effort moves, but a larger effort overcomes a smaller resistance. Thus a gain of distance and speed is made possible.

When the effort arm and resistance arm are equal in length, the mechanical advantage is always 1. The distance the effort moves is equal to the distance the resistance moves; there is no gain of force or distance or speed. What is accomplished is a transfer of force and a change in direction.

In the first-class lever, the fulcrum is between the resistance and effort. The effort and resistance move in opposite directions; thus we have a change of the direction of the force (from downward to upward). It may either increase the amount of force (when the effort arm is longer), or decrease force (when the resistance arm is the longer). As you know, the force is actually not decreased, rather, it takes more effort.

In the other two classes of levers, the fulcrum is at one end. As the other end moves, the effort and the resistance both move in the same direction. Thus, neither of these types changes the direction of a force. In the second-class lever, the resistance is between the fulcrum and the effort. Since the effort arm is longer than the resistance arm, the

second-class lever increases the amount of a force. In the third-class lever, the effort is between the fulcrum and resistance, which means the resistance arm is longer than the effort arm. In the third-class lever, there is an increase in distance and the speed of the force.

Examples for each class of lever include the following:

First-class lever:	crowbar, seesaw
Second-class lever:	wheelbarrow, nutcracker
Third-class lever:	fishing pole, shovel

EIGHT STEPS IN DETERMINING CONTENT FROM OBJECTIVES

STEP 1: Read available material on the topic.

STEP 2: Divide material into large coherent units.

STEP 3: Develop broad, general goals.

STEP 4: Develop course objectives, behaviorally stated and including conditions and standards where necessary.

STEP 5: Identify general content areas that must be covered to insure the student's ability to perform each objective.

STEP 6: Develop subobjectives for the course objectives.

STEP 7: Analyze the subobjectives for specific content aterial to be covered so that the students can achieve the performance requirements.

STEP 8: Develop content.

1. A lever is:

   _____ A. A complex machine

   _____ B. A rigid bar supported at some point

   _____ C. A rigid bar

   _____ D. Something to support the fulcrum

2. The fulcrum is:

   _____ A. The force

   _____ B. The load to be moved

   _____ C. The point around which the lever rotates

   _____ D. The long, rigid bar

3. "Resistance," as we have defined it, means:

   _____ A. Friction between the lever and the fulcrum

   _____ B. The object to be moved

   _____ C. Friction between the force and the lever

   _____ D. The force applied to the fulcrum

4. By "effort" we mean:

   _____ A. The force placed on the lever to manipulate the resistance

   _____ B. The force of the resistance resting on the lever

   _____ C. The force of the fulcrum supporting the lever

   _____ D. The force placed on the fulcrum

5. Identify A, B, and C.

   A = _____

   B = _____

   C = _____

6. The diagram in item 5 exemplifies one of the three kinds of levers. Briefly describe this kind of lever, using your answers for 5A, 5B, and 5C in the description.

_____

_____

_____

1. Look at the examples of levers on the screen. Is the fulcrum between the resistance and the effort?

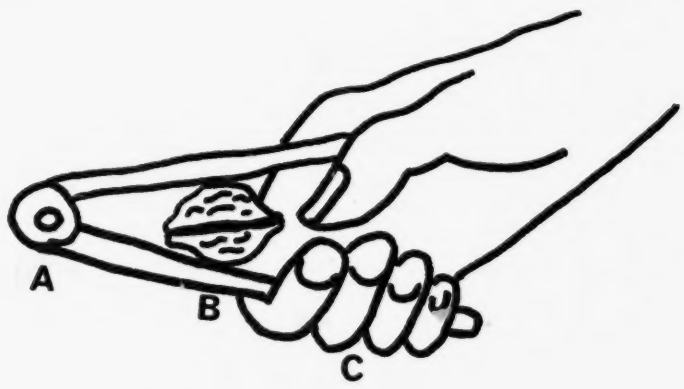
		Yes	No
Example 1:	an oar	_____	_____
Example 2:	a crowbar	_____	_____
Example 3:	a nutcracker	_____	_____

2. A nutcracker is a lever. Identify A, B, and C.

A = _____

B = _____

C = _____



3. A wheelbarrow is an example of a certain kind of lever. Which of the following statements describes this kind of lever?

_____ A. The fulcrum is between the effort and the resistance.

_____ B. The resistance is between the fulcrum and the effort.

_____ C. The effort is between the resistance and the fulcrum.

4. Which of the following is an example of a lever with the fulcrum between the effort and the resistance?

_____ A. Oar

_____ B. Nutcracker

_____ C. Seesaw

_____ D. Crowbar

5. We can describe levers in terms of the relative positions of the fulcrum, resistance, and effort. Complete the following statement.

In a lever such as a fishing pole, the _____ is between the _____ and the _____.

1. Classify each lever by writing the appropriate letter in the space provided.

F = Fulcrum between effort and resistance

R = Resistance between fulcrum and effort

E = Effort between fulcrum and resistance

_____ A. Oar

_____ B. Nutcracker

_____ C. Seesaw

_____ D. Fishing pole

_____ E. Crowbar

_____ F. Shovel

_____ G. Wheelbarrow

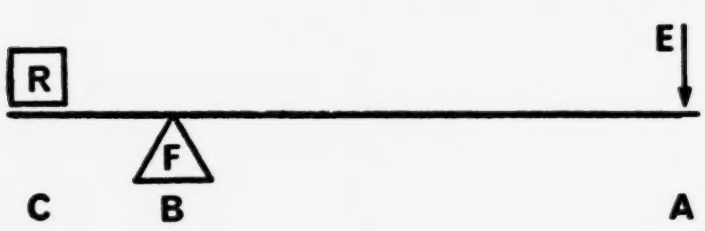
2. The "effort arm" is:

_____ A. The distance from the effort to the fulcrum

_____ B. The distance from the effort to the resistance

_____ C. The distance from the effort to the force

_____ D. The actual force which moves the resistance

3. 

Which is the effort arm?

_____ A. C to B

_____ B. A to B

_____ C. A to C

_____ D. E to A

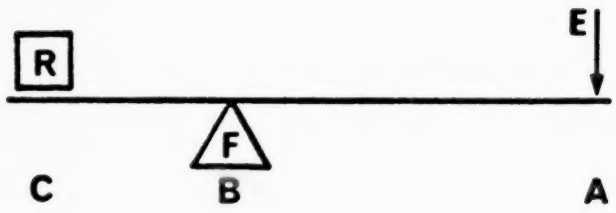
4. The "resistance arm" is:

_____ A. The distance from the resistance to the effort

_____ B. The distance from the resistance to the fulcrum

_____ C. The distance the resistance moves when force is applied

_____ D. The distance between the end of the lever and the resistance

1. 

Which is the resistance arm?

_____ A. C to A

_____ B. C to B

_____ C. B to A

2. If the effort arm on a given lever is 15 ft. and the resistance arm is 5 ft., the mechanical advantage is:

_____ A. .33

_____ B. 3

_____ C. 75

3. If the effort arm is 20 ft. and the resistance arm is 5 ft. the mechanical advantage is:

_____ A. 4

_____ B. .25

_____ C. 100

1.

What is the mechanical advantage?

_____ A. .5

_____ B. 2

_____ C. 50

2.

What is the mechanical advantage?

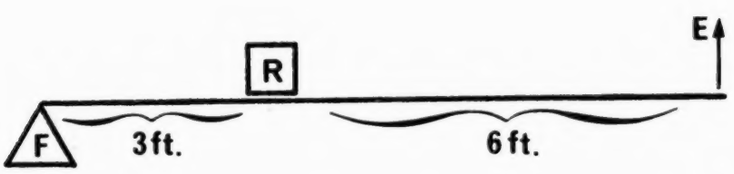
_____ A. 3

_____ B. 2

_____ C. .25

_____ D. .33

3.



What is the mechanical advantage?

_____ A. 2

_____ B. .5

_____ C. .33

_____ D. 3

1. When the effort arm is longer than the resistance arm, what is the mechanical advantage?

   _____ A. less than 1

   _____ B. more than 1

   _____ C. equal to 1

2. When the resistance arm is longer than the effort arm, what is the mechanical advantage?

   _____ A. less than 1

   _____ B. more than 1

   _____ C. equal to 1

3. When the effort arm and the resistance arm are equal, what is the mechanical advantage?

   _____ A. less than 1

   _____ B. more than 1

   _____ C. equal to 1

EIGHT STEPS IN DETERMINING CONTENT FROM OBJECTIVES

STEP 1: Read available material on the subject.

STEP 2: Divide the material into large units of information.

Classification of simple machines
Definition of a lever
Relationship of effort, resistance, and fulcrum
Determination of mechanical advantage
Three classifications of levers

STEP 3: Select general goals.

a) Understand how a lever works – fulcrum, resistance, effort
b) Compute mechanical advantage
c) Understand the advantage of each of the three kinds of levers
d) Realize that familiar devices are levers and fit them into each of the three kinds
e) Work with levers in the lab

STEP 4: Develop behaviorally stated objectives from the general goals (including conditions and standards where necessary).

a) Given examples of levers, the student will identify the fulcrum, resistance, and effort.
b) Given different fulcrum positions, the student will compute the mechanical advantage of each.
c) The student will compare and contrast the advantages of the three different kinds of levers.
d) Given examples of levers, the student will classify each into one of the three kinds of levers.
e) The student will demonstrate each of the three kinds of levers in the laboratory with the materials that are provided.

STEP 5: Identify general content areas that must be covered to insure the student's ability to perform the objectives.

a) Given examples of levers the student will identify the fulcrum, resistance, and effort

Definition of a lever
Definition of fulcrum, resistance, and effort
Label each part of lever
Go over three classes
Give practical examples of each

b) Given different fulcrum positions, the student will compute the mechanical advantage of each.

Define effort arm and resistance arm
Give the formula for mechanical advantage
Provide examples and illustrations
Go over three general rules regarding distances between "E" arm and "R" arm
Give practical examples of each

c) The student will compare and contrast the advantages of the three kinds of levers.

Go over location of fulcrum, resistance and effort on the three classes
Demonstrate each position
Explain relationship of fulcrum, resistance, and effort on each type
Give practical applications of each type
Compute the mechanical advantage for each type

d) Given examples of levers, the student will classify each into one of the three kinds of levers.

Go over the three classes
Discuss the fulcrum, resistance, and effort position on each type
Give practical examples of each type

e) The student will demonstrate each of the three kinds of levers in the laboratory with the materials that are provided.

Demonstrate first-class lever
Demonstrate second-class lever
Demonstrate third-class lever

STEP 6: Develop subobjectives from the content areas described in Step 5.

a) Given examples of levers, the student will identify the fulcrum, resistance, and effort.

1.

2.

3.

4.

5.

6.

b) Given different fulcrum positions, the student will compute the mechanical advantage of each.

1.

2.

3.

4.

5.

6.

7.

8.

9.

STEP 6: Develop subobjectives from the content areas described in Step 5.

a) Given examples of levers, the student will identify the fulcrum resistance, and effort.

1. The student will define "lever."
2. The student will define "fulcrum," "resistance," and "effort."
3. The student will label each of these parts on a given illustration of a lever.
4. The student will explain verbally the three classes of levers.
5. The student will demonstrate the three classes with illustrations.
6. The student will name two practical examples of each of the three classes.

b) Given different fulcrum positions, the student will compute the mechanical advantage of each.

1. The student will define "effort arm" and "resistance arm."
2. The student will label the resistance arm and effort arm on a given diagram.
3. The student will label the resistance arm and the effort arm on certain given practical levers.
4. The student will state the formula for finding "mechanical advantage."
5. The student will work several problems using this formula.
6. The student will state the mathematical relationship between effort and resistance when the effort arm is longer than the resistance arm.
7. The student will state the mathematical relationship between effort and resistance when the resistance arm is longer than the effort arm.
8. The student will state the mathematical relationship between effort and resistance when the resistance arm and the effort arm are equal.
9. For each of the above three relationships, the student will name one practical lever which exemplifies that situation.

STEP 7: Analyze the subobjectives for specific content material necessary to cover so that the students can achieve the requirements stated in the subobjectives:

a) 1. The student will define "lever."

give definition in class

read definition in book

2. The student will define fulcrum, resistance, and effort.

give written definitions in class

have them read definitions in book

3. The student will label each of these parts on a given illustration of a lever.

practice with simple illustrations in class

4. The student will verbally explain the three classes of levers.

show with concrete examples in class

give oral practice in describing the three classes

5. The student will demonstrate these three classes with illustrations.

show students labeled illustrations

let them practice labeling illustrations

6. The student will give two practical examples of each of the three classes.

go over a list of levers which can be divided into these three classes

give oral practice in class

b) 1. The student will define "effort arm" and "resistance arm."

give these definitions in class

have them read definition in book

2. The student will label the effort arm and the resistance arm on a given illustration.

show labeled sketches

give simple illustrations to practice

3. The student will label resistance and effort arms on certain given practical levers.

demonstrate this in class with several levers

give practice in lab

4. The student will state the formula for finding "mechanical advantage."
   - give the formula in class
   - explain the rationale for the formula
   - give examples of problems
5. The student will work several problems using this formula.
   - go over problems with them in class
   - let them do problems for homework
6. The student will state the mathematical relationship between the effort and resistance when the effort arm is longer than the resistance arm.
   - compute this mathematically to demonstrate general rule
   - demonstrate this relationship in lab
   - state general rule
   - give examples of levers in this field
7. The student will state the mathematical relationship between effort and resistance when the resistance arm is longer than the effort arm.
   - same as above
8. The student will state the mathematical relationship between effort and resistance when the resistance arm and the effort arm are equal.
   - same as 6
9. For each of the above three relationships, the student will give one practical lever which exemplifies that situation.
   - have students list as many examples of each kind that they can
   - add levers they have forgotten

STEP 8: Compile all of the content and related materials that you have specified for each subject area.

UNIT TWELVE

SUMMARY

The single, most important influence on content should be the objectives. For this reason, we say that the objectives should be developed first, and the content considered afterwards.

In "real life," however, teachers are faced with researching and reviewing given texts and instructional materials on the topic first, and then stating broad, general goals.

Even so, we must narrow and define the content by analyzing specific objectives. Starting from the broad goals and general content, we develop specific objectives and then determine the specific content needed to help the student achieve those objectives.

We have outlined an eight step process by which content can be determined from objectives. The first step involves reading as much available material on the subject as possible. The second step is to divide the subject matter into large, coherent units. Step 3 is to state one or more general goals for each unit. The fourth step requires the development of behaviorally stated objectives for each goal. In step 5, general content areas are identified to insure the student's ability to perform the objectives.

There is a rationale for breaking down the content areas – and that is the sequencing of the content according to the following classifications: first, verbal; second, discrimination; and third, motor performance. This involves moving from the more simple tasks of verbalizing to the more complex tasks of discriminating and finally actual motor performance.

Step 6 involves developing subobjectives for the content areas identified in the previous step. In step 7 each subobjective is analyzed for specific content material that must be covered so that the student can achieve the requirements stated in the subobjectives. The last step, step 8, is to compile all of the content and related materials specified for each subject area.

UNIT THIRTEEN

OBJECTIVES

1. Given content material, the student will divide the material into large units of information.

2. Given a general goal developed from a content selection, the student will develop a behaviorally stated objective.

3. Having developed a behaviorally stated objective based on a given content selection, the student will identify, in writing, relevant content areas.

4. Having identified relevant content areas to the main objective, the student will develop subobjectives based on those content areas.

5. The student will analyze the subobjectives for relevant content material necessary to clarify those subobjectives, and will then list the relevant content material under each subobjective.

MERCANTILISM

In the Seventeenth Century a new economic theory was developed which would influence the relationship between all the important colonizers of that time and their colonies. Included in this group of colonizers was Britain, and, of course, the thirteen American colonies were part of her empire. This new economic theory, known as mercantilism, induced the British to impose certain trade restrictions on American colonists. Later, these restrictions would add to the colonists' list of grievances leading to revolution.

According to the theory of mercantilism, a nation should have what we call today a favorable balance of trade. By this, it is meant that a nation should make itself wealthy by collecting more gold from selling its goods abroad than it spends abroad for importing other country's products. And more important than the balance of trade, the nation should make itself secure against the other warring and colonizing powers by becoming self-sufficient. To be safe, no country should have to depend on another for its vital needs, domestic or defensive.

Under the mercantile theory, a colony's main reason for existing was to serve the mother country. Insofar as possible, the colony should provide the mother country with whatever she needed. Some colonies (mostly Spain's) had great quantities of gold and silver, while others, like those in America, could offer commodities such as sugar and tobacco to the mother country. Also, the colonies provided military materials such as ships' masts and timber. Moreover, the colonies were to serve as markets for the mother country's manufactured products; hence no industries were to be developed in the colonies which might compete with those of the colonizer. Under mercantilism, then, the colonies need not trade with any other country, and the colonizer and colonies would function as an independent, integrated unit.

Perhaps the best example of mercantilism in practice was found in France during the reign of Louis XIV (1643-1715). This was largely due to the policies of Jean Baptiste Colbert, finance minister between 1661 and 1683. Mercantilism was a means to an end for Colbert. By making France wealthy and powerful, Colbert would gain the pleasure of the King and hence be rewarded with more power. Regardless of the motive, however, the majority of Colbert's policies were in line with the doctrine of mercantilism. He was thoroughly

convinced, for example, that France must acquire as much gold as possible. Among other mercantilistic practices, Colbert established strict control of trade, and he encouraged the settlement of Martinique, Guadeloupe, Santo Domingo, Canada, and Louisiana.

To implement mercantilism effectively, governments had to maintain strict control of trade. The French Government, for instance, raised tariffs on foreign goods, paid foreigners to start industries in France, and prohibited skilled laborers from leaving the country. The French colonies could send their products only to France or to other French colonies, and they could only receive imports from France.

In the British colonies, the situation was not much different. Britain, like France, attempted to control the colonies' trade in the interest of the British Empire as a whole. In order to implement mercantilism, Parliament passed successive Acts of Trade and Navigation from 1651 to 1776, which theoretically controlled the trade of the American colonies. Under these laws, certain "enumerated commodities" such as tobacco, cotton, indigo, and sugar had to be sent to England. British merchants would then sell these products to other countries for a handsome profit. This practice increasingly irritated colonial merchants who would have liked to have made the profit themselves. In addition to sending these products to England, the colonies were required to have all homeward bound American ships stop at a British port to pay duties on any merchandise they might have acquired in Europe. The resulting rise in prices of foreign goods increased the market in the colonies for British goods.

British regulations, however, were not strictly enforced. In order not to provoke colonial resistance, many of the British customs officials turned their heads to certain illegal trading activities. This was called a policy of "salutary neglect." It was easy, therefore, for the colonists to get into the habit of evading British legislation, and smuggling was soon considered a right. Consider the danger if and when the British should tighten up the enforcement of existent laws.

Illegal trade for the colonies was essential. The colonies bought more from Britain than they sold to her, and, consequently, more money was going out of the colonies than coming in. Taken to the extreme, this process could slowly drain the colonists' money supply out of the country. So, to make up the difference, the colonists resorted to illegal trade with Europe, Africa, and particularly the non-British West Indies. The colonists developed what were known as Triangular Trade Routes.

One example of such a route would be a triangle between the West Indies, the American Eastern Seaboard, and Africa. First, the colonists would get molasses from the West Indies which they would subsequently make into rum in New England. Then they would take the rum to Africa and trade it for slaves which would later be traded in the West Indies for more molasses to make more rum and on and on. In this manner, the thirteen colonies gained enough gold to buy British manufactured goods. A time would come, however, when the British would prevent this illegal trade by actually enforcing their laws.

Between the British tradition of self-government and the policy of salutary neglect, the American colonies became more and more independent between the years of 1651 and 1776. They would obey the British trade laws they liked, and they would ignore the laws they disliked. When Britain tried to make them obey all laws, the spark for revolution was kindled.

EIGHT STEPS IN DETERMINING CONTENT FROM OBJECTIVES

STEP 1: Read the selection entitled "Mercantilism."

STEP 2: Divide the material you have just read into large units of information.

STEP 3: Select a general goal:

The student will understand the relationship between mercantilism and the American Revolution.

STEP 4: Develop a behaviorally stated objective from the above general goal.

EIGHT STEPS IN DETERMINING CONTENT FROM OBJECTIVES

STEP 1: Read the selection entitled "Mercantilism."

STEP 2: Divide the material you have just read into large units of information.

the definition of mercantilism
the application of mercantilism
the effect of mercantilism on the relationship between colonies and colonizers
the need for smuggling in American colonies
the French use of mercantilism
disadvantages for colonies
effect of salutary neglect
effect of enforcement

STEP 3: Select a general goal:

The student will understand the relationship between mercantilism and the American Revolution.

STEP 4: Develop a behaviorally stated objective from the above general goal.

The student will write an essay showing the relationship between mercantilism and the American Revolution.

STEP 5: Identify general content areas that must be covered to insure the student's ability to perform the objective.

Objective: The student will write an essay showing the relationship between mercantilism and the American Revolution.

a)

b)

c)

d)

e)

f)

STEP 5: Identify general content areas that must be covered to insure the student's ability to perform the objective.

Objective: The student will write an essay showing the relationship between mercantilism and the American Revolution.

a) mother and child relationship between the American colonies and England

b) Britain's view of the American colonies under mercantilism as one of dependency

c) disadvantages of mercantilism for the colonists

d) restrictions placed on the colonists

e) importance of smuggling to the colonies

f) effect of salutary neglect on the colonists

STEP 6: Develop subobjectives from the 5 content areas described in STEP 5.

a)

b)

c)

d)

e)

f)

STEP 6: Develop subobjectives from the 5 content areas described in STEP 5.

a) The student will explain in writing the practical and philosophical effect of mercantilism on the relationship between the colonies and Britain.

b) The student will write an essay contrasting Britain's view of the American colonies with the colonies' view of themselves.

c) The student will list the disadvantages of mercantilism for the colonies.

d) The student will list the mercantilistic restrictions placed on the colonists by England.

e) The student will write an essay on the economic and political importance of smuggling to the colonists.

f) The student will write an essay analyzing the psychological, political, and economic effects of "salutary neglect" on the American colonists.

STEP 7: Analyze the subobjectives for specific content material necessary to cover so that the students can achieve the requirements stated in the subobjectives.

a) Explain in writing, the practical and philosophical effects of mercantilism on the relationship between the colonies and Britain.

b) Write an essay contrasting Britain's view of the American colonies with the colonies' view of themselves.

c) List the disadvantages of mercantilism for the colonies.

d) List the mercantilistic restrictions placed on the colonists by England.

e) Write an essay on the economic and political importance of smuggling to the colonists.

f) Write an essay analyzing the psychological, political, and economic effects of "salutary neglect" on the American colonists.

STEP 7: Analyze the subobjectives for specific content material necessary to cover so that the students can achieve the requirements stated in the subobjectives.

a) Explain, in writing, the practical and philosophical effects of mercantilism on the relationship between the colonies and Britain.
   - define theory of mercantilism
   - give examples of economic relations between colonies and colonizers
   - explain philosophical meaning of mercantilism for the colonies

b) Write an essay contrasting Britain's view of the American colonies with the colonists' view of themselves.
   - Britain's view: dependent and subservient; colonies exist only to serve Britain
   - Colonists' view: not subservient; free Englishmen with all rights
   - potential danger in differing views

c) List the disadvantages of mercantilism for the colonies.
   - profit to Britain – not colonies
   - little industry in colonies
   - taxes and duties
   - colonies dependent
   - more expensive for colonies
   - colonies could buy and sell only as directed

d) List the mercantilistic restrictions placed on the colonists by England.
   - Acts of Trade and Navigation
   - Sugar Act
   - Molasses Act
   - shipping requirements
   - industrial requirements
   - enumerated products

e) Write an essay on the economic and political importance of smuggling to the colonists.
   - balance of trade
   - need for money to buy English goods
   - Triangular Trade Routes
   - effect if smuggling stopped

f) Write an essay analyzing the psychological, political, and economic effects of "salutary neglect" on the American colonists.
   - appearance of equality with English independence
   - prosperity
   - freedom to do as they wish
   - effect if Britain's trade laws were enforced

STEP 8: Derive content.

UNIT THIRTEEN

SUMMARY

This unit provides further practice in determining content from objectives. The same steps followed in Unit 12 are followed in the practice exercise for this unit.

Here again is the eight step procedure for determining content from objectives: step 1 – read all available content material on the subject; step 2 – divide the content material into large, coherent units; step 3 – develop a general goal or goals; step 4 – develop behaviorally stated objectives; step 5 – identify general content areas that must be covered to insure the student's ability to perform each objective; step 6 – develop subobjectives for the course objectives; step 7 – analyze the subobjectives for specific content material to be covered so that the students can achieve the performance requirement; and finally step 8 – develop the content for the course.

UNIT FOURTEEN

OBJECTIVES

1. The student will be able to list four ways a programmed lesson plan contributes to the effectiveness of instruction.

2. The student will be able to state which instructional document of the course blueprint is used first when preparing a programmed lesson plan.

3. The student will describe the three steps taken in a programmed lesson plan after questions have been sequenced.

4. The student will fill out a "student response sheet" answering questions and completing statements required by a programmed lecture.

1. List the four ways a programmed lesson plan contributes to the effectiveness of instruction.

   A. _____

   B. _____

   C. _____

   D. _____

2. When preparing a programmed lesson plan the first document of the course blueprint that is implemented is the: _____

   _____

3. Describe each of the three steps after you have developed the sequence responses for each objective.

   A. _____

   B. _____

   C. _____

General Rule

Any time a presentation is about:

- an object or a portion of an object,
- a relationship between parts or components, either in terms of location or movement or effect on each other,
- a drawing,
- or anything requiring the student to respond or make some form of discrimination,

use a visual.

STUDENT RESPONSE SHEET

1. What is the five letter word made up of the initials for the air tank and regulator this diver is wearing? _____

2. What do the letters stand for? _____

   _____

3. What are the two major components?

   _____ A. _____ B. _____ C.

4. One atmosphere equals _____ of pressure. Increase one atmosphere every _____ feet of water depth. Increase in pressure every foot is _____.

5. Determine the pressure for each depth.

   A. 33 feet _____ B. 100 feet _____

   C. 66 feet _____

6. The volume of a balloon taken down to 33 feet will be reduced to _____ the surface volume.

7. Boyle's Law.

Pressure	
2 atms	1/2 surface volume
3 atms	___ surface volume
4 atms	___ surface volume

8. If the pressure inside an air space is the same as the pressure outside, the walls of the air space:

   ____ A. tend to be pushed in.

   ____ B. tend to be pushed out.

   ____ C. are not pushed either in or out.

9. Why wouldn't an experienced scuba diver dive with a head cold or sinus irritation?

   _____

   _____

10. What relationship should there be between the pressure of the air that the regulator furnishes to the diver and the surrounding water pressure? _____

_____

_____

11. The pressure of the air in a full scuba tank of a certain size is approximately 2200 psi. What is the function of the regulator? _____

_____

_____

NOTES:

Set A

1. What was the name of the Navy vessel that went to the deepest part of the deepest ocean? _____

2. How deep did it go? _____

3. When? _____

4. What is the name of the trench in which that deepest spot is located? _____

5. What is the air pressure (approximately) in the standard tank referred to during the presentation? _____

6. What is the name of the tube that provides an air passage between the middle ear and the throat? _____

Set A ☐

Set B

1. What is the air pressure at sea level? _____

2. Water pressure increases how much with each foot of depth? _____

3. Water pressure is twice that of atmospheric pressure at what depth? _____

4. Air compressed to five atmospheres will be what fraction of its sea level volume? ___

_____

5. What is the function of the scuba regulator? _____

_____

_____

6. Why should a scuba diver never hold his breath as he ascends after inhaling from his scuba regulator? _____

One point for each correct answer.

Set A

1. Trieste
2. 35,800
3. 1960
4. The Mariana's Trench
5. Approximately 2,200 psi (Mark it wrong if you forgot to write psi or pounds per square inch.)
6. Eustachian tubes

Set B

1. 14.7 psi (Mark it wrong if you forgot to write psi or pounds per square inch.)
2. 0.445 psi (To be correct, you had to write psi.)
3. 33
4. one-fifth
5. You could say this either of two ways: to provide the diver with air at the same pressure as the surrounding water, or to reduce the pressure of the air as it comes from the tank to the pressure of the surrounding water.
6. Because as the outside water pressure is reduced, the air inside will expand and, depending on the depth from which he is ascending, can do severe damage or kill the diver.

OBJECTIVES:

1. Will be able to produce the following identifications and names:
   - A. Shown a scuba tank and regulator or given a description, will be able to name them "scuba" equipment
   - B. Will be able to list the basic scuba equipment as a tank or cylinder, and an air regulator
   - C. Will be able to state that "scuba" is an acronym for "self-contained underwater breathing apparatus"

Slide – Describe objectives – SCUBA

Slide – Letters and name – self-contained underwater breathing apparatus

Q Slide – Discrimination – air provided, not self-contained (hard hat diver)

Q Slide – Discrimination – self-contained, but no air (skin diver)

Slide – Scuba gear on diver – tank and regulator

Slide – Scuba gear – tank and regulator – self-contained, provides air

Slide – SCUBA – review name, and meaning, and equipment

Slide – Direct students to worksheet

Q1 Slide – "What is the five letter word made up of the initials for the air tank and regulator this diver is wearing?"

Slide – Answer "Scuba." "And what do the letters stand for?"

Slide – Answer "Self-contained underwater breathing apparatus."

M-C Q3 Slide – "What are the two major components of scuba? Choose either A, B, or C."

Slide – Answer "Tank and regulator (choice B)."

ENR – Tank contains compressed air, not pure oxygen.

Slide – Compressed air, two reasons: store as much as possible – second reason, more explanation.

Stimulus	Response	Class
1. Picture or description of tank and regulator	Identify as SCUBA	V
2. SCUBA consists of . . .	Tank and regulator	V
3. SCUBA stands for . . .	Self-contained underwater breathing apparatus	V
4. Atmospheric pressure	14.7 pounds per square inch	V
5. Abbreviation — pounds per square inch	psi	V
6. One atmosphere increase in pressure . . .	33 feet	V
7. Increase in pressure every 33 feet	14.7 psi	V
8. Increase in pressure every foot	0.445 psi	V
9. Pressure = 0.445 psi per foot (or 14.7 psi per 33 feet) plus . . .	14.7 psi (one atmosphere at surface)	V
10. Relationship of volume at surface and depth of 33 feet	Volume at 33 feet reduced to 1/2 surface volume	V
11. Relationship of volume at surface and depths of 2, 3, and 4 atmospheres	At 2 = 1/2; at 3 = 1/3; at 4 = 1/4; etc.	V
12. Boyle's Law: as pressure is increased . . .	The volume is decreased	V
13. Unequal pressure — two sides of divider . . .	Greater pressure exerts force on divider	V
14. Body contains air filled compartments, including . . .	Middle ear, sinuses, lungs, throat, nasal passages	V
15. Pressure exerts no force on divider . . .	If pressure equal on both sides	V
16. Diver must breathe air whose pressure is . . .	Same pressure as surrounding water	V
17. Purpose of regulator	Reduce air pressure from tank to same as water pressure	V
18. Pressure of air provided by regulator . . .	Always same as water pressure	V
19. Diver ascending should never . . .	Hold his breath	V

OBJECTIVES:

2. Will be able to state that air pressure (atmospheric pressure) at sea level is 14.7 psi.

3. Will be able to state that water pressure increases by 14.7 psi every 33 feet, and 0.445 psi every foot of depth.

4. Will be able to calculate water pressure at any depth on the basis of the figures 14.7 psi/33 feet or 0.445 psi/foot, plus 14.7 psi due to atmospheric pressure which is part of the total pressure.

Slide – Pressure of air on surface due to weight of air above surface, called atmosphere pressure.

Slide – Air pressure of 14.7 psi at sea level.

Slide – Example – weight of air plus weight of water in 8 foot pool equals almost 20 psi.

Slide – ENR – 1960 – Navy, Trieste, Mariana's Trench, deepest spot, 35,800, 6 miles plus, press about 8 tons.

Slide – Review – atmospheric pressure – 14.7 psi; every foot of depth, approximately 0.445 psi; at 33 feet, pressure doubled.

Slide – Pressure at any depth includes 14.7 psi surface pressure. (Slide shows increase of 14.7 psi every 33 feet.)

Q Slide – What is pressure at 165 feet – DON'T DISCUSS.

Q Slide – (Slide gives choices: "73.5 psi," "88.2 psi," "other.") 73.5 is wrong.

Slide – 165 ÷ 33 = 5, add 1 for surface = 6, times 14.7 = 88.2 psi.

Slide – Review – 1 atm = 14.7, 1 atm/33 feet; 0.445 psi/foot.

Slide – Trieste – 35,800 × 0.445 = 15,931.

Slide – 15,931 + 14.7 = 15,945.7. Ton = 2,000. Almost 8 tons psi.

Q4 Slide – Answer question four.

Slide – Answers – 14.7 psi (repeat psi), 33 feet, 0.445 psi.

Stimulus	Response	Class
1. Picture or description of tank and regulator	Identify as SCUBA	V
2. SCUBA consists of . . .	Tank and regulator	V
3. SCUBA stands for . . .	Self-contained underwater breathing apparatus	V
4. Atmospheric pressure	14.7 pounds per square inch	V
5. Abbreviation – pounds per square inch	psi	V
6. One atmosphere increase in pressure . . .	33 feet	V
7. Increase in pressure every 33 feet	14.7 psi	V
8. Increase in pressure every foot	0.445 psi	V
9. Pressure = 0.445 psi per foot (or 14.7 psi per 33 feet) plus . . .	14.7 psi (one atmosphere at surface)	V
10. Relationship of volume at surface and depth of 33 feet	Volume at 33 feet reduced to 1/2 surface volume	V
11. Relationship of volume at surface and depths of 2, 3, and 4 atmospheres	At 2 = 1/2; at 3 = 1/3; at 4 = 1/4; etc.	V
12. Boyle's Law: as pressure is increased . . .	The volume is decreased	V
13. Unequal pressure – two sides of divider . . .	Greater pressure exerts force on divider	V
14. Body contains air filled compartments, including . . .	Middle ear, sinuses, lungs, throat, nasal passages	V
15. Pressure exerts no force on divider . . .	If pressure equal on both sides	V
16. Diver must breathe air whose pressure . . .	Same pressure as surrounding water	V
17. Purpose of regulator	Reduce air pressure from tank to same as water pressure	V
18. Pressure of air provided by regulator . . .	Always same as water pressure	V
19. Diver ascending should never . . .	Hold his breath	V

UNIT FOURTEEN

SUMMARY

This unit contains guidelines for preparing a group instructional presentation, and both lectures and demonstrations are designed in the same way. The first step is to arrange the objectives in the order in which they are to be learned. This sequence is usually evident in the S-R table. The next step is to identify the relevant questions the students are to answer. The questions should test not only terminal behavior, but also interim objectives and any critical S-R units. It may be necessary to prepare a display for some questions, for example, multiple-choice questions. After identifying the questions, the instructor determines how to lead up to each question. Additional content for clarification or enrichment is also identified. Then the visuals are specified – both those needed to go with the questions and those to be used to lead up to the questions. The basic rule for visuals is this: when presenting information about anything that can be visualized, use a visual.

The instructor is now ready to prepare a programmed lesson plan. One suggestion is to set up a notebook with two pages side by side – the S-R table on the right and the presentation sequence on the left. The presentation sequence should include a brief description of the particular objective or subobjective, an indication of where each question is to be asked, and an outline of the content and enrichment material that will be presented to prepare the student for each question.

UNIT FIFTEEN

OBJECTIVES

1. The student will explain the purpose of developmental testing.

2. The student will explain the purpose of validation testing.

3. Given a list of statements, the student will select the ones that correctly describe the significance of the results obtained from validation testing.

4. The student will describe three possible causes of an incorrect answer to a criterion test item.

5. The student will explain when spaced review is not necessary.

6. Given the conclusion, reached as a result of traditional testing principles when test items are answered correctly by either 100% or zero% of the students, the student will contrast in writing the conclusions reached as a result of criterion testing when test items are answered correctly by: a) 100% of the students, b) zero% of the students.

7. The student will explain what is meant by the following: a) an achievement test "samples the objectives," b) a criterion test "measures all of the objectives."

8. Given a situation where a criterion test is so long that it appears impractical to use it as a final examination, the student will describe the recommendation that should be made in the following situations: a) when you are about to begin the validation process, b) when validation has been completed and the course is ready for class use.

9. Given a test score chart with all necessary information, the student will compute: a) average pre-test score and the percentage, b) average post-test score and the percentage.

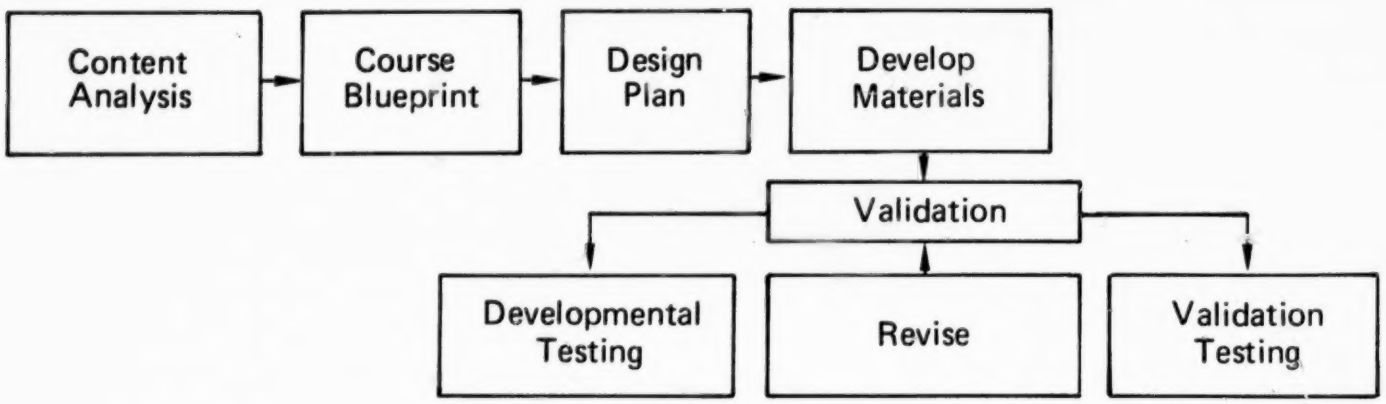
10. Given the pre-test score and post-test score, the student will compute the gain score.

11. Given the pre-test score and post-test score, the student will compute the actual gain.

12. Given the pre-test score and the perfect score, the student will compute the possible gain.

13. Given the pre-test score and the post-test score, the student will compute the following in the given order: 1) actual gain, 2) possible gain, 3) modified gain.

NOTES:



Developmental Testing: _____

Purpose: _____

When: _____

Validation: _____

Purpose: _____

When: _____

_____

General description of developmental testing procedures.

a. Instruct one student

b. Administer criterion test

c. Revise

d. Instruct one student and test

e. Revise

f. Instruct one student and test

g. Revise

h. Instruct small group and test

i. Revise

1. What does the term "developmental testing" mean?_____

_____

_____

_____

2. Developmental testing is part of validation. True or false? _____

3. Why put instruction through developmental testing?

_____ A. So you can evaluate the students.

_____ B. So you can develop effective instruction.

_____ C. So you can tell whether or not your objectives are valid.

_____

NOTES:

1. During developmental testing, individual students or small groups of students can be used to test the effectiveness of instruction. At what point would you make revisions?

   _____ A. After each student or group has completed the segments being tested.

   _____ B. After a reasonable number of students – say six – have individually completed the segment.

   _____ C. After approximately 20 to 30 students have completed the segment.

2. If, during developmental testing, you find that a student has made an error on a criterion test item, what do you do first in order to find out what went wrong?

   _____ A. Examine the test item to determine whether it is ambiguous.

   _____ B. Examine the teaching sequence related to that test item.

   _____ C. Find out, by questioning, what he did and did not learn.

NOTES:

1. Why is a validation test necessary following the developmental testing? That is, why can't we assume that all inadequacies were located and eliminated during the developmental testing? _____

_____

_____

_____

2. What do the results of the validation test indicate to us? (Mark each statement T or F.)

_____ A. Whether the objectives are valid.

_____ B. Whether further revisions must be made.

_____ C. Which students are successful.

_____ D. How well the course works under class conditions.

3. What characteristics of a programmed course make it especially easy to evaluate for revision purposes? _____

_____

_____

_____

4. The criterion test, which measures all objectives, can tell us what the student learned and did not learn. What feature of a programmed course tells us where the breakdown occurred? _____

_____

_____

NOTES:

1. If at the end of an eight hour course or block of instruction a student responds incorrectly to a criterion test item, what are three possible causes of the error that you would want to consider?

   A. _____

   B. _____

   C. _____

2. Suppose a student responds correctly during Unit One and scores 100% on the post-test for that unit. Suppose further that the course is 30 units in length, and that on the final criterion test he misses all test items related to the objectives of Unit One. What is the most obvious possible cause of this finding? _____

   _____

   What should be done to avoid this problem? _____

   _____

3. Under what circumstances do we not need spaced review in a course? _____

   _____

   _____

   _____

4. If a set of post-test questions is relevant and measures criterion performance, and every student gets every question correct after missing most items on the pre-test, what does that tell us?

   _____ A. Nothing: the test is useless since it doesn't discriminate among students.

   _____ B. The instruction is effective.

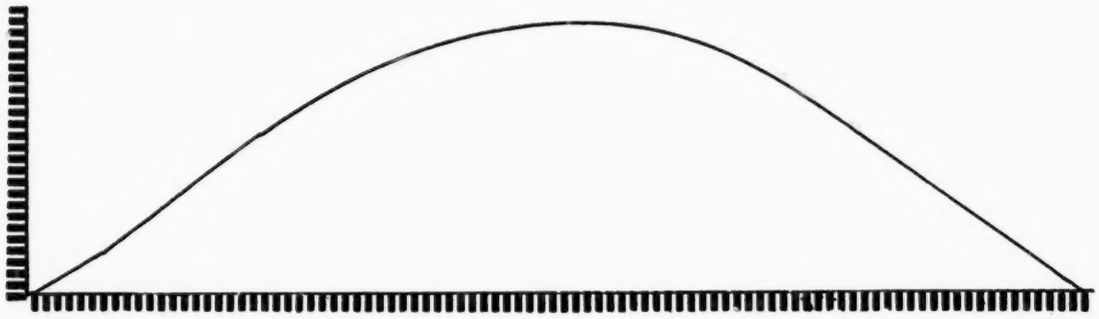
   _____ C. The questions are too easy.

5. The purpose of a test is to:

   _____ A. Discriminate among students.

   _____ B. Evaluate student capability.

   _____ C. Assign letter grades.



SCORES

1. This distribution of post-test scores is highly undesirable if all test items are criterion measures of the course requirements. Explain. _____

_____

_____

2. Does the distribution above seem to indicate that the test discriminates among students? _____ Explain. _____

_____

3. A test item that every student got right does not discriminate among students; neither does a test item that every student gets wrong. Criterion test items should be answered correctly by approximately ____percent of the students.

4. Traditional testing principles would specify that test items that are answered correctly by 100% or by none of the students should be discarded since they do not discriminate. But what kind of information do we get from criterion test items answered correctly by:

100% of the students _____

_____

Zero% of the students _____

_____

1. An achievement test samples the objectives but a criterion test measures all of the objectives. Explain the following:

   "Samples the objectives" _____

   _____

   _____

   "Measures all of the objectives" _____

   _____

   _____

   _____

2. If a criterion test is so long that it appears impractical to use it as a final examination, what recommendation regarding the final examination would you make in the following situations?

   A. You are about to begin the validation process _____

   _____

   B. Validation has been completed and the course is ready for class use. _____

   _____

   _____

   _____

_____

NOTES:

Test Item	STUDENT A	B	C	D	E	F	G	H	I	J	Total	Pre
1a	a	a	a	a	a	a	a	a	a	a	10	2
2b	(a)	b	b	(a)	b	b	(a)	(c)	b	b	6	0
3c	(d)	(a)	(b)	c	(b)	(a)	c	c	(d)	(a)	3	0
4a	(b)	(d)	(d)	(d)	a	(d)	(d)	a	(d)	(d)	2	0
5d	(a)	d	d	d	d	d	d	d	d	d	9	8
6c	c	c	c	c	c	(b)	c	c	c	c	9	1
7b	(d)	b	b	(c)	b	b	b	(a)	b	b	7	3
8b	b	b	b	b	b	b	b	b	b	(d)	9	0
9d	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	0	0
10c	(a)	c	c	c	c	c	c	c	c	c	9	2
Right	3	7	7	6	8	6	7	7	7	6	64	
Pre	0	4	2	0	2	0	3	2	0	3		16

Total Possible Score 10

Average pre-test score_____ Percentage_____%

Average post-test score_____ Percentage_____%

NOTES:

1. Pre-test – 10%
   Post-test – 30%
   Gain – _____

2. Pre-test – 70%
   Post-test – 90%
   Gain – _____

3. Pre-test – 40%
   Perfect score – 100%
   Possible Gain – _____

4. Pre-test – 40%
   Post-test – 70%
   Actual Gain – _____

5. Pre-test – 20%, Post-test – 65%
   Possible Gain – _____
   Actual Gain – _____

6. Modified Gain = Actual Gain divided by Possible Gain
   _____ divided by _____ = _____

NOTES:

UNIT FIFTEEN

SUMMARY

A criterion test consists of test items or testing situations designed to demonstrate achievement of all the objectives for a course of instruction. During the development testing of an instructional course, a pre-test consisting of items dealing with the appropriate objectives is given to the students before the instructional material is administered. After the students have gone through the material, a post-test covering the same objectives is given. The information derived from these two tests is used as a basis for revising the instruction.

After a course has been through enough cycles of developmental testing, it is field tested with larger numbers of students in a setting closely resembling that in which the completely developed and validated course will be administered. A final examination is administered after the students have completed the course. This examination may be either a criterion test or an achievement test; a condensed version of the criterion test may also be used.

Scoring is an important procedure for discovering how successful or unsuccessful the instruction has been; consequently, it must be done carefully and methodically. One method of scoring is by computation. The actual gain for each student is the number of items answered correctly on the post-test minus the number answered correctly on the pre-test. The modified gain is the actual gain divided by the possible gain.

This unit also discusses advantages and disadvantages of gain scores, and modified gain scores. Numerical scoring is useful validation data in that it might indicate how well the course has achieved its objectives, and how many objectives have been achieved by each student. Numerical scores can also indicate alternatives that have been learned by the students.

The primary deficiency in numerical scoring is its inability to measure a student's actual performance. The numerical score might be high, even though the student cannot do the task. It is critical that we look beyond the numerical scores to evaluate in a qualitative way as well as on a quantitative basis.

GLOSSARY

Achievement test
A test designed to estimate the amount of learning by each student, generally in comparison to other students, by sampling the content of the relevant instruction.

Affective objective
An objective dealing with emotions or feelings indicated by words such as interest, appreciation, enthusiasm, motivation, and attitudes.

Behavioral objective
(See Instructional objective)

By-passing
A method which permits a student to skip certain parts of the instructional material because of prior performance capability.

Chain
A sequence of stimulus-response pairs in which each response acts as or produces the stimulus for the next response. A sequence in which there are alternative responses is not a chain.

Clarification
Information presented to help make the subject clear and unambiguous.

Cognitive objective
An objective which deals with the thought processes (knowledge, understanding) rather than with the affective or psychomotor behaviors.

Conditions
That part of an objective which identifies the situations or circumstances (when, what, where, and how) under which the behavior stated in the objective is to occur.

Confirmation
A form of feedback to a student telling him whether or not his responses are appropriate and what progress he is making.

Content analysis
Identification of relevant instructional objectives by analyzing reference materials, existing instructional materials, and curriculum design materials.

Contracts
Individualized lessons based on objectives in specific subject matter areas and designed at a level of the student's prior achievements and capabilities.

Course blueprint
The three components — S-R table, objectives, and criterion test items — which specify the desired results of instruction and provide the primary goal for instructional design.

Course performance requirements
Terminal performance stated in terms of what the student must do, under what circumstances, and with what degree of accuracy.

Covert performance (response)
Behavior that is not readily observable (e.g., thinking, solving, discriminating).

Criterion test
An examination used to evaluate the attainment of each instructional objective and to validate the course. Used also as a design document (see Course blueprint).

Criterion test item
A written and/or actual performance item which is used to measure the achievement of an objective.

Developmental testing
Part of the validation process in which the instructional material is successively tested and revised to identify and correct weaknesses in the material.

Discrimination objective
An instructional objective involving the ability to respond to differences among stimuli.

Educational goals
Descriptions of instructional intent, usually defined in broad terms that identify content topics or instructional events to be experienced by the student. These descriptions refer to the instruction rather than to consequences of instruction.

Effective instruction
Instruction which is successful in producing the intended result. Effective instruction may, however, be inefficient, and care must be taken to build both effectiveness and efficiency into an instructional system.

Efficient instruction
Instruction which produces effective results with the minimum possible expenditure of time, effort or resources.

Enrichment
Content that is included because it is assumed to add interest value, or to have other communication, emotional, or instructional values, but which is not essential in helping the student attain the performance requirements.

Entry level performance (ELP)
The level of performance the student brings with him that is relevant to the course requirements (CR). Instruction must bridge the gap between ELP and CR.

Gain score
The difference between the pre-test and post-test scores.

Instruction
A series of procedures and events designed to produce learning of specified and measurable objectives.

Instructional objective
Description of the form of the behavior that instruction is to produce, stated in terms of what the student is to be able to do (explain, describe, discuss, solve, manipulate, etc.), the conditions under which the action is taken, and where appropriate, a standard of accuracy or speed. In some cases the product of the students' actions rather than the actions themselves are described (e.g., an essay, typed page, object produced, setting on a gauge, etc.), the desired characteristics of the product defining what the student is to do. The behavior described, or its consequence, is observable and measurable.

Instructional technology
A set of principles and procedures used to analyze instruction, design instruction, instruct, and provide quality control. A systems approach to instruction. A developmental process that utilizes a variety of principles and techniques in order to develop instruction that achieves its objectives.

Interactive instruction
Instruction in which the student is required to respond frequently to the instruction. In a tutorial setting there is a continuous exchange of information between tutor and student. Programmed presentations of various kinds require the student to respond, and the feedback information is used during validation.

Interim objectives
Temporary performance which aids the student in attaining the terminal performance requirement, but which is usually dropped after terminal criterion is reached.

Modified Gain score (G)
The ratio of the actual gain to the maximum possible gain.

$$G = \frac{\text{Post} - \text{Pre}}{\text{Total Possible} - \text{Pre}}$$

Motor performance objective
A statement specifying performance involving physical movement, acting on some part of the environment. (Sometimes referred to as psychomotor skills.)

Overt indicator
Overt behavior which indicates that a desired covert behavior has occurred.

Overt performance (response)
Visible behavior (e.g., audible or observable) which is measurable.

Performance (change)
A change in student behavior capability from the beginning of instruction to the end of instruction; a modification of students' performance capability.

Remedial instruction
Instruction in subjects or skills required by the entry level standards of a course, or by performance standards, or by some other standard that a student does not meet.

Response
A unit of behavior that can be identified in terms of its relation to specific stimuli.

Standard
The part of an objective which specifies the speed, accuracy, or ability required for a terminal performance. Frequently implied rather than specified.

Stimulus
The event, situation, condition, signal or cue to which a response must be made.

Stimulus-response pair
A stimulus and the response which follows it. One of the component parts of performance.

Subobjective
A specification of performance which is a part of a larger objective.

Validation
The process of developmental testing, validation testing, and revision of instruction to be certain that the instructional intent is achieved.

Validation testing
A late stage in the validation process, following developmental testing, which involves testing the instruction on a relatively large group of students and under class conditions.

Validated instruction
Instruction which has been shown to do what it was intended to do, to change performance capability according to the specifications included in the instructional objectives.

Verbal background
Verbal behavior which serves to prompt performance (verbal, discrimination, or motor performance), but which is not itself part of the performance requirement. Usually involves covert responses, but can be overt.

Verbal objective
Overt or covert verbal behavior, using words, mathematical processes or other symbols, spoken or written. The verbal behavior itself is a part of the performance requirements.